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TEACHER'S RESOURCE GUIDE
y
The Exploring Science Program
RED BOOK (6)

by
Peter Beugger
Aldo Bianchini
Bill Biles
Louise Steele

Doubleday Canada Limited
Toronto

Doubleday Australia
Sydney

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TEACHERS' RESOURCE GUIDE
to accompany
The Exploring Science Program
RED BOOK (6)

PURPOSES

The two main purposes of the *Teacher's Resource Guide* to accompany *The Exploring Science Program—Red Book (6)* are to:

1. provide you, the teacher, with some background information about the concepts, processes, and topics being developed in each unit.
2. suggest a wide variety of teaching strategies and learning activities for each unit, that complement, extend or reinforce the material presented in the textbook, and give you the resources to design a program that meets the needs of individual students.

FEATURES

The Unit Overview

The Unit Overview consists of the following sections:

Concept Development. The main concepts of the unit are discussed in terms of how they are developed in the unit; how they were introduced and presented in the preceding units, and how the concept relates to child development.

Process Development. This feature describes the processes that are developed in the activities of the unit. It also includes some in-depth discussions of process skills that particularly relate to that unit.

Related Units. All units in the Exploring Science Program that further develop a concept, or that develop related concepts, are listed.

Materials and Advance Planning. Materials needed for a student, or a group of students, to carry out the activities, are listed. In some instances, suggestions are made for advance planning.

Background Information

The purpose of this feature is to provide you with additional information on the topics presented in the text. You may wish, at your discretion, to inject some of this additional information into class discussions.

Teaching Strategies

The Teaching Strategies include:

Suggested activity, discussion, or research. These suggestions are meant to enrich, reinforce, or complement the concepts and processes presented in the text. They are interdisciplinary in nature.

Worksheets. These worksheets may be reproduced for use by individual students. They can be used to review or record material presented in the unit.

Activity Cards. The activity cards may be used in learning centres, or by individual students. They generally pose a question, or make a statement, that allows for further activity, investigation, discussion, or research.

SCIENCE PLANNING OUTLINE

TEACHER ____________________ GRADE ____________________

	BIOLOGICAL	PHYSICAL	EARTH-SPACE
SEPTEMBER			
OCTOBER			
NOVEMBER			
DECEMBER			
JANUARY			
FEBRUARY			
MARCH			
APRIL			
MAY			
JUNE			

SCHOOL-WIDE PLAN DATE: ____________	BIOLOGICAL	PHYSICAL	EARTH-SPACE
YEAR 1			
YEAR 2			
YEAR 3			
YEAR 4			
YEAR 5			
YEAR 6			
YEAR 7			

SCOPE AND SEQUENCE CHART

YEAR	LIVING THINGS (Biological Sciences)	MATTER AND ENERGY (Physical Sciences)	THE EARTH AND SPACE (Earth-Space Sciences)
ORANGE BOOK (1)	Your Senses Living Things	Sorting Light and Shadows	Time Spaces and Places
GOLD BOOK (2)	Food for Animals and You Environment	Measuring Magnets	The Moon Rocks and Soil
BLUE BOOK (3)	Seed Plants Animal Behaviour	Heat and Temperature Sounds Around You	Water in Your Environment Location, Motion, and Force
BROWN BOOK (4)	Plant Growth and Behaviour Animals and Their Environment	Work and Machines Solids, Liquids, and Gases	Air and Weather Watching the Sky

GREEN BOOK (5)	Small Living Things Your Body	Electricity on the Move Light	The Changing Land Mapping the Earth
RED BOOK (6)	Interacting with your Environment Plant and Animal Life Cycles	Matter and You Changes in Energy	The Earth in Space Ecosystem Earth
(7)	Ecology: Interaction in the Environment Biology: The Study of Living Things The Human Body: A Study of Yourself	Science: Something People Do Energy: For Work and Motion Technology: Using Science	Earth: Its Nature and Importance to You Weather: The Changing Atmosphere Water: More than a Resource Universe: Exploring Environments in Space

RED BOOK (6)

Unit 1: Interacting with Your Environment

Pages 6-47

UNIT OVERVIEW

Concept Development

In the preceding levels of the program, the following concepts were introduced and developed: objects and events in the environment can be perceived and described by using one or more of our senses.

This unit develops further the ideas that concrete experiences involving seeing, hearing, touching, smelling and tasting are the ways that information and ideas are absorbed in the process of developing concepts. As these experiences are collected and combined by the nervous system and brain, learning and understanding results.

Unit 1: "Interacting with your Environment", consists of three chapters. Chapter one introduces students to some interesting details about their sense organs. Chapter two considers reflexive behaviour and how the human nervous system works. The third chapter examines the learning process.

Process Development

In this unit, students *observe* the properties of some of their senses, they *compare* their senses in terms of their properties, they *collect data* to substantiate their observations, and they make *inferences* based on their observations and comparisons.

Related Units

Your Senses *Orange Book (1)*
Environment *Gold Book (2)*
Sounds Around You *Blue Book (3)*
Light *Green Book (5)*
Science: Something People Do *Exploring Matter and Energy (7)*
The Human Body: A Study of Yourself *Exploring Living Things (7)*

Materials and Advance Planning

The following list includes the materials that a student, or in some cases a group of students, will need to carry out the activities in this unit. In some instances other materials may be substituted for those on the list.

Hairpin or paper clip; paper and pencils for 2 or 3 people; ruler; blindfold; small pieces of onion, apple, raw potato; chair.

For the additional activities described in this guide: popcorn maker; popcorn; metre stick; clock; variety of objects with different textures (felt, glass, wood, metal); stopwatch; empty can; pail of warm water; pail of cold water; syrup or sugar; salt water; lemon or grapefruit juice.

BACKGROUND INFORMATION

Chapter 1: Discovering your environment, pages 8-19

Someone has said that the senses are the gateways to the mind. This is more than just a figurative expression. The sensations a person picks up truly affect how well that person perceives the environment. Sensations are received through the sense organs: the eyes, the ears, the nose, the tongue and the skin.

Many people would probably say that their eyes are their most important sense organ for keeping them in contact with their environment. Eyes, like other sense organs, contain many neurons, or tiny nerve cells. Two kinds of light-sensitive neurons make up the inner layer, known as the retina, at the back of the eyeball. These light-sensitive neurons in the retina are known as rods and cones.

Cones are concentrated in the centre of the retina, where the eye receives its sharpest images. These neurons work best in strong light and enable a person to see colour.

Rods are distributed outside the centre region of the retina, where the images are fuzzier. Rods are helpful in seeing at night. Because the rods are located on the sides of the retina away from the region where sharp images are formed, objects are not seen as clearly at night as during the day. Rods cannot detect colour; therefore, objects most often look gray or black at night.

Another kind of neuron makes up the optic nerve, which carries the visual information received by the retina to the brain.

You may discover that one or more pupils in your class are colour-blind. This problem is more common with males than with females because colour blindness is inherited by a sex-linked gene. Colour-blind persons will typically confuse red and green or see them as shades of gray. They will see other colours normally. Very rarely are all colours seen only as black and white or as shades of gray.

The second sense organ to be considered is the ear. The ear has three main parts: the outer ear, the middle ear, and the inner ear. The first two parts simply pass on sound vibrations to the inner ear, located inside the skull. In the inner ear there are sound-sensitive nerve endings located inside the cochlea, a spiral passage shaped like a snail's shell and filled with liquid. When vibrations pass into the inner ear, the liquid in the cochlea begins to vibrate, stimulating the nerve endings. From these nerve endings, nerve impulses are instantly sent to the brain, where they are interpreted. At that point a person becomes aware of a sound.

Also in the inner ear are three tubes, formed into half circles and called the semicircular canals. A person's sense of balance is controlled by these canals. Each of the three tubes of the semicircular canals is arranged in a different position relative to the other two. The tubes contain a thin liquid. As a person's head moves, the liquid in the canals sloshes, stimulating nerve endings inside the tubes. Impulses are passed along nerves to the brain, providing information about the position of the head at the time.

The skin is another sense organ that keeps a person informed about the environment. Scattered unevenly and at various depths in the skin are nerve endings sensitive to touch, pressure, heat, cold and pain. Only one kind of stimulus can be picked up by each kind of nerve ending. Nerve endings are clustered closer together in some places than they are in others. As might be expected, there are many touch-sensitive nerve endings in the fingertips and lips. The "Finding Out" on page 15 will enable your pupils to identify some other sensitive areas of the skin.

Odours in the environment are picked up by the sensory neurons in a person's nose. These neurons, located in the mucous lining of the nasal cavity, are sensitive to odours caused by gaseous substances in the air. When a person breathes in air, the gaseous substances in the air are dissolved in the moist mucous lining. If the gaseous substances have an odour, these odours are detected by the sensory neurons that carry signals to the brain. When people are exposed continually to one odour, the sensory neurons may become insensitive to that odour. Curiously, other odours may be detected very well at the same time.

Some scientists believe that nerve cells of the nose are sensitive to four primary odours: acid, fragrant, rancid, and burnt odours. They suggest that all other odours are simply a combination of the primary odours.

People can taste things because of certain chemoreceptors, which are clusters of nerve cells that form tiny bumps known as taste buds. Most taste buds are found on the tongue — in the front, on the edges, and in the back. Taste buds are grouped into small mounds on the tongue called papillae. The papillae are connected to one of two nerves that carry the taste signals to the brain.

When tasting things, a person must often rely upon other senses, such as the sense of smell. Your pupils may judge for themselves how much they can rely upon their sense of smell to identify foods when they do the "Finding Out" on page 19 of the text.

Chapter 2: Reacting to your environment, pages 20-31

When people pull away from a hot object, sneeze, blink, yawn and perspire, among other such behaviours, they are reacting automatically. These automatic behaviours, called reflex actions, do not require thinking. For this reason they can be completed much more quickly than voluntary actions. Such speed keeps people from harming themselves, as when they touch a hot stove. If people had to think about the stove being hot before they withdrew their hand, dangerous burns could result.

The text describes the process by which spinal reflex actions occur, such as pulling the hand away from a hot object. Some reflex actions, however, such as those occurring in the head region do not involve the spinal cord at all. Blinking is such a case. It involves a brain reflex action. If nerve endings on the surface of the eye are stimulated, an impulse is carried by sensory neurons to a reflex centre in the brain. Connecting neurons in the brain reflex centre then pass the message on to motor neurons that cause the eyelids to blink. Only afterward does the message reach the conscious part of the brain.

Chapter 3: Adapting to your environment, pages 32-43

Learning helps people and animals adapt to their environment by providing them with the means to survive and to succeed. The ways people and animals learn range from the simple to the complex.

At the simplest level is trial-and-error learning. A chick learns what to eat in this way. At first it pecks at almost any bit of food scattered on the ground. But after a while, it learns to select the food that tastes best.

Skills that involve muscular movement are usually learned by trial and error. Someone learning to pitch a ball might throw it too high or too low. After pitching many times, the pitcher learns that certain ways are better than others to pitch the ball. As learning proceeds, the brain learns to give proper orders to the arm muscles. With feedback from errors, pitchers can usually smooth out their performance to the point where good pitching becomes habitual or automatic.

It is important that your pupils realize that their ability to learn increases when they organize what they are studying. When organized, information makes more sense and becomes easier to remember. Looking for patterns is one way to organize learning. Identifying the most important facts is another way. Outlining, explaining the information to someone else, and drawing diagrams are other ways for your pupils to organize information they wish to learn.

You have very likely shown your students how they can sometimes learn more easily when they associate what they are learning with something else. The information they need to learn may be part of a play, a game or a rhyme. As they master the lines for these fun activities, the pupils memorize facts they need to know. A rhyme like "'I' before 'e' except after 'c'" has helped many pupils learn to spell certain words correctly.

At the highest level of learning is the ability to learn by reasoning or solving problems. Carefully defining the problem helps people to consider possible solutions. The brain has the capacity to screen out solutions so that the most promising one can be selected for testing first. This avoids wasted time in trial-and-error attempts. People can also evaluate their results and thus modify further trials.

A pupil's emotions and self-concept are other important factors affecting the ability to learn. An angry or upset pupil is too busy dealing with his or her emotions to be concerned with productive learning. Also, if a pupil does not believe that he or she can succeed, it is likely that failure will follow.

TEACHING STRATEGIES

The purpose of the following activities and teaching strategies is to provide you, the teacher, with a wide variety of suggestions that can be used, together with the material presented in the textbook, to help develop the processes and concepts of this unit.

Unit Introduction, pages 6 and 7

- Awareness of what is around us can be developed as we learn to use our senses more efficiently. A greater awareness often means a greater appreciation for those things in our environment that we often take for granted. Awareness and appreciation of the objects in our environment can provide many satisfying and pleasurable moments for all of us.
- Place a covered pan containing popcorn seeds on a hot plate before the students. Explain to the students that their senses will soon tell them what you have in store for them. *Discuss the senses* that will help them.
- Turn on the heat and make the popcorn. Warn the students about "jumping to conclusions". Caution them to: "Let your senses tell you".
- As the students enjoy the popcorn they might write a poem about "Popcorn and the Senses". Ask the students, "How does popcorn feel?".
- Provide a number of sealed shoe boxes or equivalent each containing some mysterious object.
- The boxes would be numbered and passed among the students in order that they might feel, listen and even smell the carton in order to determine what is in each box.
- The students would use Worksheet 1 to record their guesses or inferences.
- The opening of the boxes should be of interest to all.

Chapter 1: Discovering Your Environment, pages 8-19

- A worthwhile objective of many studies of the environment is to make us more aware of what is around us.
- Following the reading and discussion of page 8 the students might be taken for a short walk around the school yard. Upon returning to the classroom, have the students complete as much as they can of "Worksheet 2, I saw-heard-smelled-felt".
- Have the students evaluate their own awareness of the outdoor environment at this stage of the study.
- The students can study the outdoor environment through the classroom windows in some locations. A procedure might be to give the students a period of time to observe the outdoor environment.
- Have each of the students prepare a question about what can be observed in the environment.
- Seat the students in such a way that they cannot see outdoors. Have the students test the group with their question in an oral discussion.
- "Worksheet 3, Our Environment" can be used to have the students give some thought to what can be found in their environment.
- Pages 9-10, Using Your Eyes, may be read and discussed.
- Students can use their eyes to search out specific items in their environment. Small groups of students could be formed and the groups located outdoors. Each group could attempt to name an item they can see in the environment for each letter of the alphabet.
- Adaptation to the dark takes place as the cells called rods become more sensitive. Students can investigate the question: Do all people adapt to the dark in the same amount of time?
- Some students may plan their own investigations.
- "Activity Card 1, Adaptation to the Dark" describes one method of carrying out the investigation.
- Some students may be given the task to compare the eye and a camera. These students might prepare charts or diagrams to explain the similarities for the class. Overhead transparencies that the students can make might be used also.
- Pages 11 to 13, Using Your Ears, may be read and discussed.
- Tape a number of common sounds and have the students try to tell what makes the sound. Tape sounds like an engine running, a food mixer, a fire burning and a pencil sharpener.
- Students might be assigned to tape sounds for the group. Some student might tape pleasant sounds; others, unpleasant sounds.

1. Prepare a number of cards listing on each card the name of an object or creature that makes a distinctive sound, e.g. a typewriter, a crow, the wind, running water, a boiling kettle and a saw.
2. Each student draws a card.

3. Students are called on one at a time to present the sound of the object or creature listed on the card.
4. Other students attempt to name the object or creature that makes the sound.

— Some people hear certain sounds farther from the source of the sound than other people.
— "Activity Card 2, Lend me your Ears" describes an investigation the students might undertake to study the hearing abilities for a group of students.
— Some students might be given the opportunity to construct a model of the ear.
— The neurons in the semicircular canal help to control the body's sense of balance.
— "Activity Card 3, Sense of Balance" describes an investigation that has the students comparing their own sense of balance to that of other students. It is suggested that students might work in groups of six. The students displaying the best balance in each group would then be compared.
— Students might work together to determine the noisiest location and the quietest location in their community. Colour coding on a map of the community might be completed.
— Students might list all the sounds they can hear from a particular location in the community. Post the lists.
— Students can learn a great deal about the importance of their senses by having a handicapped person come to the classroom and explain to the students how they have learned to contend with a handicap. Has their dependence on other senses increased?
— A class activity might have each student bring a noisemaker of some type to school one day. Encourage students to be creative in their choice of noisemakers. How much noise can the students make if they all work their noisemakers at the same time? STOP — and be very quiet.
— Questions for class discussion:
1. Where is noise pollution most evident in our community?
2. How might we control noise pollution?

— Have some students interview parents or other persons who work in extremely noisy locations. How do they contend with the noise?
— Pages 14 to 17, Using Your Skin, may be read and discussed.

Activity One:
— Collect a number of blindfolds that students can use to investigate their sense of touch.
— Students can be made more aware of the many textures they can recognize because of the sensory neurons within their skin.
— Collect fairly large pieces of many materials: e.g. glass, paper, plywood, felt, wool, cardboard, cotton, arborite.
— Show the students each sample and name the materials.
— Blindfold one of the students.
— Have the blindfolded student place his/her hand palm down on each sample of material and try to name each material correctly.
— The rest of the students can use "Activity Card 4, Sense of Touch" to record the sense of touch of the blindfolded students.
— Test other students in this manner.

Activity Two:
— Students will find it interesting to investigate how long it takes for the nervous system and the muscles of the body to respond to a stimulus (and squeeze).
— "Activity Card 5, Pass the Squeeze" describes the activity that has the whole group working together investigating the touch stimulus.

Activity Three:
— Another activity that will permit the students to consider their sense of touch will have them structuring animal shapes using plasticene or some equivalent material while blindfolded.

— The observations made for the "Finding Out" on page 15 can be recorded in the ACTIVITIES FOR EXPLORING SCIENCE book (page 2).
— Heat and Cold, page 16, can be read and discussed.
— The sensory neurons that tells us how hot or how cold an item is, appear to lose this sensitivity in some situations.
— "Activity Card 6, Hot and Cold" describes an investigation that has students considering the neuron's sensitivity to heat and cold in the skin.
— Using Your Tongue, page 17, can be read and discussed.
— Before undertaking any investigation that will have children tasting foods you must determine if any of the children are allergic to any foods to be used.
— Each area of the tongue has taste buds that are more sensitive to one taste than to others. In groups of three, the students can investigate which area of the tongue is sensitive to sweet tastes, which are sensitive to sour tastes and which are sensitive to salty tastes.
— Prepare three samples of a sweet (syrup or sugar), a salt and a sour taste (lemon or grapefruit juice).
— The taster will sit with his tongue out.
— The tester will place a drop of sweet on the tip of the taster's tongue.
— Repeating the above, the tester will place a drop of sweet on the back of the taster's tongue.
— Determine which area was most sensitive to the sweet. Record the result.
— Test each member of the group in the same way.
— Then test each member of the group to determine which area of the tongue is most sensitive to salt and to a sour taste.
— Use "Worksheet 4, Taste Test", to record the results of the tests.
— Repeat the tests if necessary.

- Students may record the results of the "Finding Out" on page 19 in the ACTIVITIES FOR EXPLORING SCIENCE book (page 4).
- After a discussion of For You to Think About, page 18, the students might be assigned further research concerning care of the sense organs. "Worksheet 5, Caring for Our Sense Organs" may be used to record the students' data or students might design their own recording sheets.

Chapter 2: Reacting to Your Environment, pages 20-31

- Pages 20-21, Reacting without thinking, may be read and discussed.
- A good discussion of the picture on page 20 will make the students aware of the simple reflexes of the body.
- Students who are interested in collecting data might use "Worksheet 6, Observing Simple Reflexes" that will have them observing people, collecting data and drawing conclusions concerning simple reflexes.
- Students may record the results of the "Finding Out" on page 21 in the ACTIVITIES FOR EXPLORING SCIENCE book (page 5).
- Pages 22 to 30, Your nervous system, may be read and discussed.
- Parts of the nervous system can become more meaningful if students study the diagram on Page 23 and then diagram the nerves, spinal end and brain on an outline of their own body or a smaller model.

  Careful placement of the nerves and nerve endings using pencil crayon should make the students aware of the structure and the location of the nervous system.

  Industrious students might work together and use coloured string or wool for nerves that they glue to their body shape.
- The "Finding Out", page 26, provides an excellent opportunity for students to investigate the senses and develop the process skills involved. A metrestick may be more appropriate than a 30 cm ruler. Students may record the results of this "Finding Out" on page 6 of the ACTIVITIES FOR EXPLORING SCIENCE book.
- Conditioned Reflexes, page 30, can be read and discussed.
- You might have one or more of the students research the work of the Russian physiologist, Ivan Pavlov, who studied how dogs could be conditioned to salivate at the sound of a bell. Pavlov's work might be explained to all the students.

Chapter 3: Adapting to Your Environment, pages 32-43

- If we cannot change something, we may have to adapt to it. You might discuss with your students what it means "to adapt" to something. You could also discuss those things we cannot change in our environment such as the temperature or the period of daylight.
- In order to develop the concept that learning is important to people in adapting to their environment, you might ask students to consider how we have to learn to adapt to: noisy traffic, power failures, dirty drinking water, freezing temperatures, a broken television or hordes of mosquitos.
- Pages 33 to 37, What are some ways you learn?, may be read and discussed.
- In order to introduce this concept you might have someone the students know, like the principal or school secretary, come to the room dressed in a disguise and wearing a hood of some kind. Be sure that the students will not recognize the person.
- The task for the students is to learn the identity of the mysterious person without touching the person or the disguise.
- As you consider the five ways that we learn, you might provide a learning experience for each method that the students can try.

1. LEARNING BY TRIAL AND ERROR:

- To determine which of five overturned cups covers a candy.
- To name my cousin whose name starts with the letter M.
- To determine the number of pennies in a closed container.

2. LEARNING BY REPETITION:

- Learning to write your name with your left hand.
- Learning a dance step.
- Learning to draw a perfect circle free hand.

3. LEARNING BY ORGANIZING:

- Learn the names of the planets of the solar system by remembering a catchy jingle.
  M_____ V_____ E_____ M_____ J_____ S_____ U_____
  N_____ P_____
- To determine the food which is most popular with the students in the school.
- To have a group of students complete a single task most efficiently, e.g. to prepare a 150-word dictionary.

4. LEARNING BY ASSOCIATION:

- Learning to associate a location with a familiar object, e.g. peanuts in a shell are associated with a ball park. What places do students associate with: a pencil, a flag, a cash register or hot dogs? Add to the list.
- Learning to associate a mood with a task such as setting up the Christmas tree or writing a difficult examination.

5. LEARNING BY REASONING:

- Learning to make people smile.
- Learning to choose what to wear to a party.
- Learning the name of a mystery guest behind a curtain.

- Students may record the results of the "Finding Out" on page 34 and on page 36 in the ACTIVITIES FOR EXPLORING SCIENCE book (pages 8 and 10).
- Pages 38 to 42, What are some things that affect learning?, may be read and discussed. In order to introduce this topic you might carry out an experiment with the help of the students. Explain the following:

  We will investigate how well each member of the class can complete a task in two different environments.

  ENVIRONMENT A: Students may discuss the task with one or more students in the group for the time alloted for the task.

  ENVIRONMENT B: Students in this group will work at the task alone and will not say a word to other members of the group while working on the task.

  1. Determine a simple task (e.g. to memorize a short poem or to study details of a map).
  2. Separate the class into two groups.
  3. Let each group work at the task for the same amount of time.
  4. Test both groups together.
  5. Determine if the students in one environment learned more than students in the other environment.
  6. Discuss the results with the students.
     (a) Would the results vary for different types of tasks?
     (b) Would the results change if students worked in their separate environments several times?

- Another learning environment that might be investigated with the students would be learning in an environment with music playing compared to learning in an environment that is very quiet.

  Investigations of this type provide an opportunity for students to consider:
  - the skills of experimenting
  - making inferences
  - interpreting data
  - hypothesizing a general statement
- A discussion of page 41 offers the opportunity to consider the benefits of a positive self-concept.
- "Worksheet 7, Rate your self-concept" may be used by the students to consider their self-concept.
- To further the discussion with students concerning things that affect learning you might ask students to give their opinion about how these facts might affect their learning abilities:
  (a) their diet
  (b) how far they live from school
  (c) the number of books they read
  (d) the number of brothers and sisters they have
  (e) the time they go to bed
  (f) how well they see

  These topics and others that the students have to offer should generate a good discussion about the many things that can affect how a person learns.

WORKERS WHO USE SCIENCE

- The information provided on page 44, Workers Who Use Science, could be studied by having students construct a number of questions that would be answered true or false by other members of the class. Each student might be responsible for *five* questions that would be presented to the class in some form. (e.g. Psychometrists make up tests to help discover how people learn .... True or false?)

It feels like a . . .
It sounds like a . . .

	My guess:	It is:
Box No. 1		
Box No. 2		
Box No. 3		
Box No. 4		
Box No. 5		

My senses that helped me:

Interacting With Your Environment, Worksheet 1

I saw-heard-smelled-felt . . .

(A) THREE SOUNDS I HEARD:	(B) I NOTED THESE ODOURS:

(C) AN ANIMAL I SAW:

(D) I FELT:

(E) THREE MOVING THINGS I SAW:

(F) THE BEST WORD TO DESCRIBE MY AWARENESS IS:

EXCELLENT GOOD FAIR POOR

Interacting With Your Environment, Worksheet 2

Temporary things:

____

____

____

____

____

We may hear:

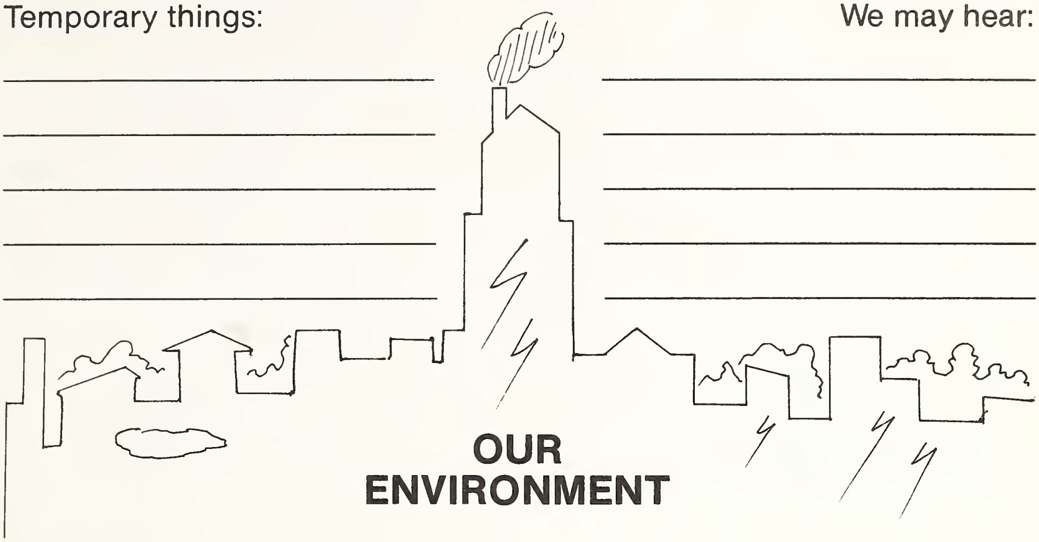
____

____

____

____

____



OUR ENVIRONMENT

Never move:

____

____

____

____

____

Common smells:

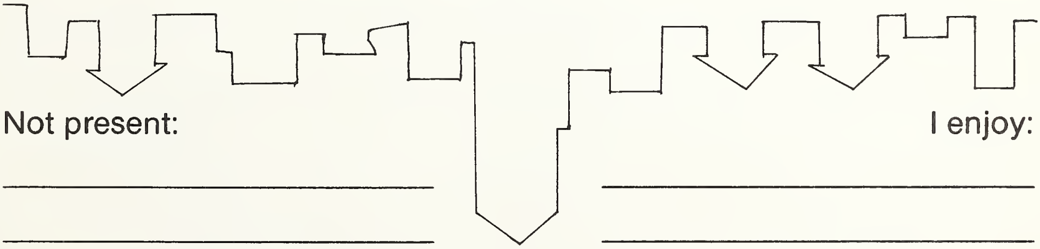
____

____

____

____

____



Not present:

____

____

____

____

____

I enjoy:

____

____

____

____

____

Interacting With Your Environment, Worksheet 3

Adaptation to the dark

Do all people adapt to the dark in the same amount of time?

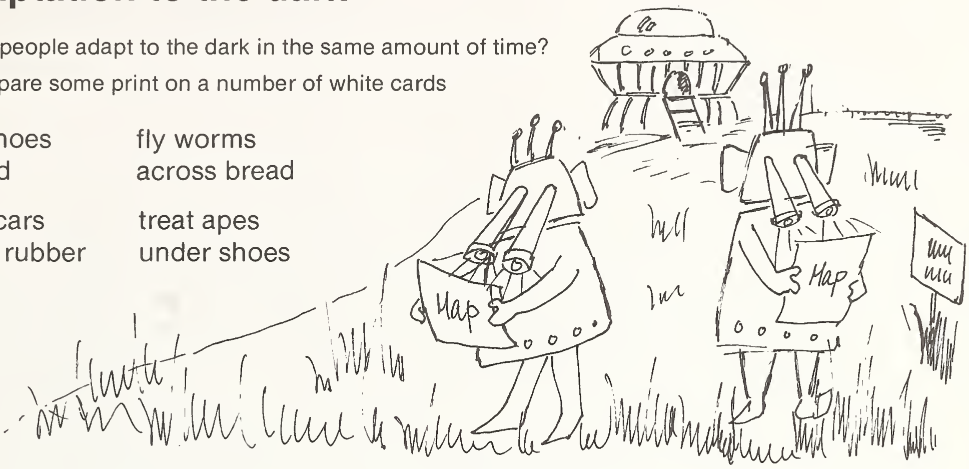
- Prepare some print on a number of white cards

eat shoes
in bed

fly worms
across bread

melt cars
upon rubber

treat apes
under shoes



- Mount one card on the wall and cover it.
- Seat the person to be tested a measured distance from the card.
- Turn out the light to darken the room and uncover the card at the same time.
- Time how long it takes for the seated person to read the card. Record the time.
- Test several people this way.
- What can you conclude from this investigation?

Name	Time	Name	Time
1.		4.	
2.		5.	
3.		6.	

I conclude that:

Interacting With Your Environment, Activity Card 1

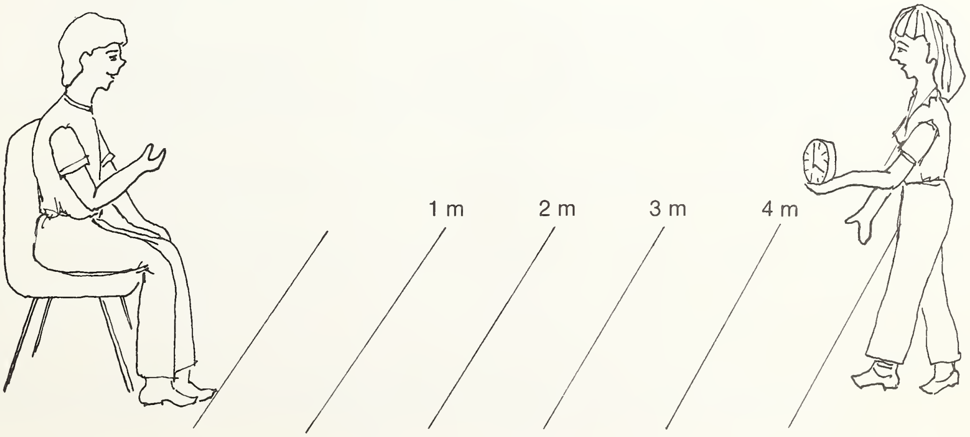
LEND ME YOUR EARS . . .

Some people can hear certain sounds from a further distance than can other people.

You will need: an alarm clock/metre stick/chair/masking tape/blindfold

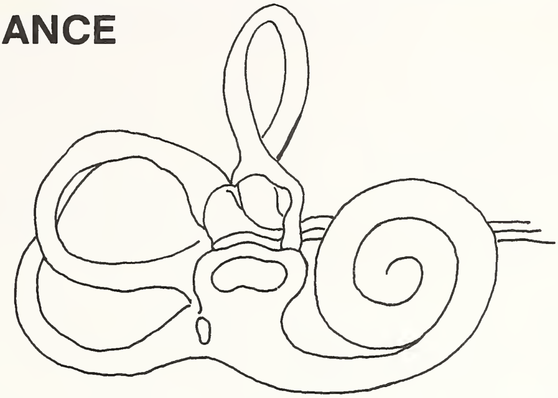
- Tape markers every metre distance from a chair located at one end of the room or a hall.
- Blindfold one of the group you will test and seat him or her in the chair.
- Stand across the room or down the hall holding a ticking clock that the blindfolded student cannot hear.
- Walk very slowly towards the seated student.
- Instruct the student to speak out when he can hear the clock ticking.
- Record the distance from you to the student at this point.
- Test other students and record the distance when they first hear the clock.

STUDENT	DISTANCE FROM CLOCK	AVERAGE DISTANCE



Interacting With Your Environment, Activity Card 2

SENSE OF BALANCE



The neurons in your semi-circular canals help your sense of balance. Compare your sense of balance with the sense of balance of others in your group.

- Place a three centimetre wide line approximately three metres long on the floor or playground.

TEST ONE

- Each member of the group will walk in a heel-to-toe fashion along the line to test their balance.
- Record each member's success. (✓)

TEST TWO

- Each member will turn their body one complete turn before they try to heel-to-toe the line a second time.
- Record each member's success. (✓)

TEST THREE

- Each member will stand and turn their body through two complete turns before they try to heel-toe the line.
- Record each member's success. (✓)

TEST FOUR

- Try three complete turns and record the results.

MEMBER OF GROUP	TEST 1	TEST 2	TEST 3	TEST 4	SCORE

- Which member of your group has displayed the best balance in this investigation?

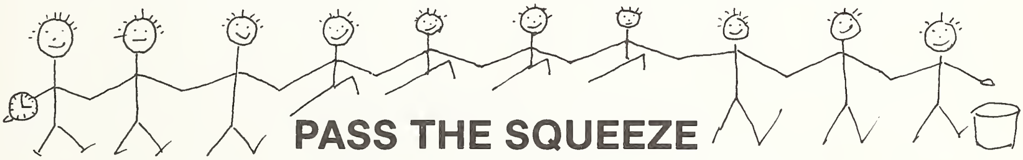
Interacting With Your Environment, Activity Card 3

SENSE OF TOUCH

- Record the sense of touch of a number of students.
- The blindfolded students must place their hands palm down on the material placed on the table in front of them.
- Record the sense of touch of the students tested. If your classmate names the material correctly place (✓) in the appropriate column.

NAMES	NEWSPAPER	FELT	GLASS	WOOL	WOOD	METAL	

Interacting With Your Environment, Activity Card 4



PASS THE SQUEEZE

You will need: a stopwatch, empty can, penny

- Form a line with your classmates or other members of your group. Hold hands.
- The first person in the line will hold a stopwatch in her or his hand. The last person will hold a penny over an empty tin can. Everyone closes their eyes.
- When everyone is ready, the first person starts the stopwatch and at the same time squeezes his or her neighbour's hand.
- When the neighbour feels the squeeze, he or she squeezes the hand of the next person. The squeeze is passed down the line.
- When the last person feels the squeeze she or he drops the penny in the can. This sound tells the time keeper to stop the watch.

1. How long did it take to pass the squeeze down the line?
2. How can the time be improved?

3. Keep a record of the time for each trial.

Interacting With Your Environment, Activity Card 5

HOT AND COLD

Investigate the sensory neurons in your skin that are sensitive to heat and cold.

You will need: A bucket of very cold water and a bucket of warm water.

- Hold one hand under the warm water tap for 30 seconds.
- Put both your hands into the bucket of cold water.
- What happens? Why?

- Hold one hand under a cold water tap for 30 seconds.
- Put both your hands into the bucket of warm water.
- What happens? Why?

Interacting With Your Environment, Activity Card 6

TASTE TEST

FOOD TASTED	AREA OF TONGUE MOST SENSITIVE			
	TASTER 1	TASTER 2	TASTER 3	TASTER 4
(SWEET) ____________				
(SOUR) ____________				
(SALTY) ____________				

Compare the results your group obtained with the results of your classmates.

Interacting With Your Environment, Worksheet 4

Caring for our 'Sense Organs'

It is important we take very good care of our sense organs at all times.

- Discuss how we might care for our sense organs with your class, your parents, a doctor or a nurse.
- Complete this chart by listing ways that we can care for our sense organs.

eyes ______________________ nose ______________________

ears ______________________ tongue ______________________

Interacting With Your Environment, Worksheet 5

OBSERVING SIMPLE REFLEXES

- Observe people in different situations over a period of time. (a day, a week), (at home, at school).
- Record a (✓) each time a simple reflex is observed.

DATE	TIME OF DAY	LENGTH OF OBSERVATION	SUBJECT'S NAME	ACTIVITY	REFLEX OBSERVED (✓)				
					COUGH-ING	YAWNING	CRYING	SNEEZING	BLINKING
		MIN.							

- Is there a relationship between the type of activity and the type of reflex observed?

- Did the time of day affect the type of reflex observed?

Interacting With Your Environment, Worksheet 6

Rate your self-concept

Use a rating from 1 to 5 (1 is high, 5 is low).

		Take the test again:	
		After ___ months	After ___ months
Do You:			
Laugh often	☐	☐	☐
Have a good memory	☐	☐	☐
Give consideration to others	☐	☐	☐
Complete tasks you start	☐	☐	☐
Arrive on time	☐	☐	☐
Get right to a task	☐	☐	☐
Eat a good diet	☐	☐	☐
Laugh at yourself occasionally	☐	☐	☐
Ask for help when in need	☐	☐	☐
Work well on your own	☐	☐	☐
Compliment a good performance by others	☐	☐	☐
Listen well	☐	☐	☐
Recognize your own talents	☐	☐	☐
Are You:			
Satisfied with yourself	☐	☐	☐
Planning some changes	☐	☐	☐

RESOLUTIONS

Take the test again after a few months.

Interacting With Your Environment, Worksheet 7

Rate your self-concept

Use a rating from 1 to 5 (1 is high, 5 is low).

Do You:

Laugh often . . . . ☐

Have a good memory . . . . ☐

Give consideration to others . . . . ☐

Complete tasks you start . . . . ☐

Arrive on time . . . . ☐

Get right to a task . . . . ☐

Eat a good diet . . . . ☐

Laugh at yourself occasionally . . . . ☐

Ask for help when in need . . . . ☐

Work well on your own . . . . ☐

Compliment a good performance by others . . . . ☐

Listen well . . . . ☐

Recognize your own talents . . . . ☐

Are You:

Satisfied with yourself . . . . ☐

Planning changes . . . . ☐

RESOLUTIONS

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Interacting With Your Environment, Worksheet 7

RED BOOK (6)

Unit 2: Plant and Animal Life Cycles

Pages 48-95

UNIT OVERVIEW

Concept Development

In the preceding levels of the program, the following concepts were introduced and developed.

There are many kinds of living things. The two broad groups of living things are the plant and animal kingdoms. Some of the characteristics of living things are that they grow and change, they reproduce their own kind, they use food for energy, they breathe, they respond to stimuli and they adapt to the environment they inhabit.

In this unit, the concept of *life cycles* is introduced. In order to carry out their life functions, living organisms continually *interact* and *change*. Each organism also has its characteristic *structure* and *function*, *behaviour* and *pattern of adaptation* to its environment.

Unit 2, "Plant and Animal Life Cycles", consists of three chapters. Chapter one discusses the fact that most living things begin as a single cell and then progress through the stages of a life cycle: youth, adult and old age. In Chapter two, the specific life cycles of three very different kinds of plants are presented: spore-bearing plants, cone-bearing plants, and flowering plants. The third chapter considers and compares the animal life cycles of fish (grunions and salmon), amphibians (frogs), reptiles (snakes) and mammals (whales and baboons).

Process Development

In the "Finding Out" activities, students are able to *observe* and *describe* some stages of a number of life cycles: chicken egg (page 59); moss (page 66); pine tree (page 69); flowering plants (page 72); apple (page 73); fish (page 74); and frogs (page 84).

The processes used in investigations such as these which involve *interactions* and *change* are:

- *observing* the characteristics of the situation before the change or the interaction.
- observing, *measuring* or *collecting data* on the change that takes place during the interaction.
- noting the *duration* or *length of time* of the changing process.
- *comparing* ways in which the objects or situations have changed.
- *inferring* possible reasons for changes or trends, from the data, observations and comparisons.

There are also opportunities in this unit for developing scientific and personal *attitudes* towards environment problems, and for using *research skills*.

Related Units

Living Things	*Orange Book (1)*
Food for Animals and You	*Gold Book (2)*
Environment	*Gold Book (2)*
Seed Plants	*Blue Book (3)*
Animal Behaviour	*Blue Book (3)*
Plant Growth and Behaviour	*Brown Book (4)*
Animals and Their Environment	*Brown Book (4)*
Small Living Things	*Green Book (5)*
Biology: The Study of Living Things	*Exploring Living Things (7)*

Materials and Advance Planning

The following list includes the materials that a student, or in some cases a group of students, will need to carry out the activities in this unit. In some cases, other materials may be substituted for those on the list.

Chicken egg; pan or dish; about 6 lima beans or kidney beans; 3 drinking glasses; paper towels; 2 milk cartons; soil; scissors; small pieces of charcoal; wide-mouthed glass container; moss; male and female pine-cones that have not dried out; knife; flower from 2 or 3 plants such as tulip, sunflower, cherry and iris; 2 or 3 different kinds of apples; bucket; two 15 L glass containers and a glass lid for one of them; aquarium gravel; aquarium plants (from a pet store); 2 male guppies; 2 female guppies; fish food; small piece of cardboard; frog eggs (from a pond or a pet store); cooked spinach; Tubifex (from a pet store); earthworms.

In preparation for this unit, locate: pine cones, earthworms, frog eggs, moss and flowers. You may need to order the moss, guppies, frog eggs, tubifex and earthworms from a pet store or biological supply house.

For the additional activities described in this guide: caterpillars; brine shrimp eggs; aquarium salt; thermometer; 1 L jar; 12 fertilized chicken eggs; incubator; brooder box; mung beans; measuring cup; 2 pieces of cheesecloth (15 cm square); shovel or trowel; 4 empty ice cream pails; tape measure; potato; peat moss; measuring cup; 1 L container; microscope; fish scales (from a fish store).

In preparation for these additional activities, locate a source of: caterpillars; dandelions; bees; fertilized chicken eggs. If you don't have an egg incubator or brooder in your school, borrow these from your local secondary school or construct them. You may need to order fertilized chicken eggs from a chicken farm, or from a biological supply house.

BACKGROUND INFORMATION

Chapter 1: The stages of a life cycle, pages 50-62

The process by which living things give rise to offspring is known as reproduction. Some organisms reproduce asexually. Asexual reproduction is the process by which new organisms are formed without the union of sex cells. Some forms of asexual reproduction are fission, budding, and spore formation. Reproduction by fission, or cell division, generally occurs in one-celled organisms, such as amoebas, at the conclusion of mitosis. Mitosis is the process by which the nucleus of a cell divides. During mitosis the genetic material in the chromosomes is duplicated, producing two complete sets of paired chromosomes—one set of paired chromosomes for each of the two resulting daughter cells. Mitosis ensures that each of the two daughter cells is identical to the mother cell.

Budding also involves cell division, but the cells formed are not of equal size. A bud forms as an outgrowth on the mother cell. When the bud is as large as the mother cell, it may pinch off and form a separate organism, or it may remain attached to the mother cell. Yeast cells often reproduce by budding.

Spore formation is another form of asexual reproduction. A spore is essentially a nucleus with a small amount of cytoplasm surrounded by a thick wall that helps it survive very cold or very dry conditions. Mushrooms, mosses and ferns are examples of plants that reproduce by spores.

In sexual reproduction, two special sex cells unite to form the first cell of a new organism. The female sex cell is called an egg cell. The male sex cell is called a sperm cell. When a sperm cell unites with an egg cell, the process is called fertilization. A fertilized egg cell receives one half of its genetic material from the male parent and one half from the female parent. Before fertilization can take place, however, the sex cells must undergo a process known as meiosis. During meiosis the number of chromosomes in the nucleus of each sex cell is reduced by half.

The process by which a new plant begins life and develops is complicated. Before fertilization can take place, special conditions (such as moisture) or special devices (such as pollen tubes) are sometimes necessary to transport a sperm cell to an egg cell. After fertilization the fertilized egg, which is the first cell of the new organism, divides several times. After the first division, the developing organism is often called an embryo. Plant embryos often grow inside seeds that provide nourishment for the embryo as it grows. Some animal embryos develop inside eggs, as in the case of birds and many kinds of fish and reptiles. Other animal embryos grow inside the body of the female, as happens in the case of most mammals.

After a seed sprouts, an egg hatches, or an animal is born, the stage in a life cycle known as youth begins. This period continues until the plant or animal is capable of reproducing. When an organism is able to reproduce, it has passed into the adult stage. The adult stage may be followed by old age, during which certain cells of the organism stop functioning as they should. As more and more parts of the organism break down, the organism completes its life cycle and dies. Therefore, death is very much a natural part of an organism's life cycle.

Chapter 2: Some interesting plant life cycles, pages 63-75

Members of the plant kingdom range from the very simple to the very complex. The three plants chosen for consideration in the text are all fairly complex plants, in that they all have a well-developed system for transporting materials throughout the plant. They are also complex in their life cycles.

The first life cycle discussed is that of a fern. The fern undergoes what is known as an alternation of generations. In the asexual generation, known as the sporophyte generation, the fern reproduces by means of spores. In the sexual generation, known as the gametophyte generation, the fern reproduces by means of sex cells.

Your pupils may have noticed brown spots on the underside of some fern fronds or leaves. These brown spots are known as sori, or collections of spore cases. Within the spore cases, spore mother cells are produced. These spore mother cells divide by meiosis. As a result of meiosis, the number of chromosomes in each spore is reduced by half.

When a fern spore falls to the ground, a new plant soon germinates. As this new plant grows, it becomes evident that it does not resemble the spore-bearing fern plant in size or appearance. This gametophyte generation is usually seen only with the aid of magnification. The gametophyte produces two distinct kinds of sex organs on a small, leaflike structure known as the prothallus. The male organ, in which sperm cells are formed, is called the antheridium (plural: "antheridia"). The female organ, in which one egg cell is formed, is called the archegonium (plural: "archegonia"). When moisture is present, the sperm cells swim from the antheridia to the archegonia, where fertilization takes place. Each fertilized egg is the first cell of the new generation — the sporophyte generation.

Perhaps the most familiar type of reproduction in plants involves the production of seeds. Seeds are a more efficient means of reproduction than are spores. Spores contain only the genetic information for the new plant, while a seed contains a plant already in embryo form. A seed also contains food for the developing plant. A spore-bearing plant such as a fern must produce many thousands of spores so that a few will survive to carry on the species. A seed-bearing plant may produce fewer seeds, because more of them can be expected to survive and to grow into plants. Some seed plants protect their seeds by surrounding them with a fruit. This is the case in angiosperms, the flowering plants. Other seed plants, the gymnosperms, carry their unprotected seeds on scales, which are often contained in a cone.

A typical gymnosperm is the pine, which has male and female cones on the same tree. However, male and female cones on the same tree mature at different times to encourage sexual reproduction between separate trees. Such a system allows the offspring to receive genetic material from two different parent trees instead of from just one parent tree. Pollen grains from the male cone are blown about by the wind. By chance, some will reach the female cones of the same species. When a pollen grain reaches an ovule in the female cone, it develops a pollen tube that then carries the sperm to the egg cell inside the ovule. After fertilization, the embryo develops inside the mature ovule, or seed. It takes about two years for all of these things to be carried out.

Angiosperms produce pollen and ovules in structures called flowers. In some kinds of plants, the male and female organs are contained in the same flower. In other kinds of plants, the male organs are separate from the female organs, being located in distinct flowers on the same plant or on different plants.

The reproductive process in angiosperms is shorter than that in gymnosperms, since most angiosperms produce seeds in a single year. Two examples of angiosperms are radish plants and corn plants. In some cases, a seed sprouts and forms a new plant that produces new seeds within a few weeks, as in the case of radish plants. Because angiosperms reproduce within one season, they can "take over" an area more easily than can gymnosperms.

Chapter 3: Some interesting animal life cycles, pages 76-91

Several animal life cycles are presented in Chapter 3, beginning with the salmon. Like most fish, salmon lay eggs in the water, but salmon eggs are somewhat protected, since they are laid beneath gravel. Other fish eggs are not so well protected. They remain exposed in the water, in constant danger of being eaten by fish and other animals. Those fish that do not provide protection for their eggs compensate by laying millions of eggs, ensuring that at least some of the eggs will survive.

Some interesting theories have been devised to explain how salmon find their way back from the ocean to their spawning grounds in fresh water. Various scientists have suggested that salmon follow currents, guide themselves by the sun or the stars, or perhaps have a geographical memory. Others say that salmon swim at random on their return to fresh water but that their numbers are so great that enough of them always reach the parent river to make it seem that all salmon try to return to their own spawning grounds. However, once the salmon reach the river, it is the characteristic odour of the river in its varying concentrations that seems to guide them to their specific spawning grounds.

The life cycle of another kind of fish, the grunion, is also included in the text. Grunions are especially interesting as an example of the complex biological clocks that control the life cycles of many animals.

"Amphibian" means literally having two lives. The life cycle of the frog bears this out. Besides the fact that a tadpole, or young frog, lives in the water and that a mature frog can live on the land, there are important structural differences that reflect the life-styles of the two. A tadpole has a long intestine suited to digesting plants. The intestine of a frog is shorter and better adapted to its insect diet. Also, the heart of a tadpole, like that of a fish, has two chambers, which are ample for an animal that lives in the water and that has gills for oxygenating its blood. The heart of a frog is three chambered, which is more suited to an animal that lives on land and that has a respiratory system with lungs.

Male and female amphibians return to a water habitat at spawning time. Large numbers of eggs are released in the water by the female and then fertilized by the male. In some frogs, either the male or the female will carry the fertilized eggs on its body to keep them from being eaten by fish.

In most reptiles such as turtles, alligators, snakes, and lizards there is no need for water to act as a medium for carrying the sperm to the egg. Fertilization takes place in the body of the female. Therefore, these animals can reproduce on the land. In most species of reptiles, fertilization occurs just before the eggs are laid. In others, the sperm may live on in the reproductive tract of the female and continue to fertilize eggs months or even years after copulation.

The eggs of reptiles are an improvement over amphibian eggs in many ways. Reptilian eggs are laid in the sand or in another protected location. The hard shell also protects the eggs from injury and from drying out. With such improvements in their eggs, reptiles do not have to lay great numbers of eggs, as do amphibians.

Some reptiles that live in very cold regions or in the water bear live young. This adaptation may have occurred because the cold ground or the cold water would not be warm enough to incubate the eggs. In some species the females merely keep the eggs inside their body until the eggs are fully hatched. In other species, the embryonic tissues, not enclosed in a shell, are adjacent to maternal tissues. This allows for an exchange of nourishment and oxygen from the female to the developing embryo — and even of waste materials from the embryo to the female. Often, members of the same species living in warmer regions still reproduce by means of eggs.

The life cycle of whales and their relatives, the dolphins, takes place only in the water. It is believed that their ancestors once lived on the land but then took to the water after a very long time.

Among some mammals an order of dominance, or "pecking order," is extremely important in their life cycle. The dominant males are the only males to mate, and since they possess the strongest physical and psychological characteristics in the group, their offspring are thus endowed with the finest genetic traits. Baboons, wolves, Barbary sheep, and bottle-nosed dolphins are just a few of the mammals that have a pecking order. Besides being given the first chance at any food, dominant males also require that as they approach, animals lower in the pecking order move away. Often signs of submission, such as lowering the tail and cringing, point out the less-dominant animals to observers.

TEACHING STRATEGIES

The purpose of the following activities and teaching strategies is to provide you, the teacher, with a wide variety of suggestions that can be used, together with the material presented in the textbook, to help develop the processes and concepts of this unit.

Chapter 1: The stages of a life cycle, pages 50-62

— Pages 49 to 51 can be read and discussed.

— The class could discuss the many stages of the human life cycle (e.g. egg, fetus, newborn, preschool, preteen, teenager, adult and senior citizen). Viewpoints could be elicited as to which of these stages students consider most advantageous.

— "Activity Card 1, Fuzzy Caterpillars" lets students collect caterpillars in the pupa stage and to observe their change into the adult stage.

— Please see the suggested activity on page 51 regarding the monarch butterfly.

— "Activity Card 2, Brine Shrimp" provides an opportunity for pupils to study the life cycle of brine shrimp. These are available from pet stores that sell tropical fish and can be purchased as eggs or live brine shrimp. Temperature is an important factor and it should remain constant. If the school thermostat drops below 23°C overnight, it is suggested that you have a lightbulb near the jars to maintain heat. Draughts also should be avoided. The students will need salt solution. You will need 150 mL of aquarium salt for every 4 L of water. This mixture should be prepared 24 hours in advance; when brine shrimp are to be placed in salt solution, this solution should be at about 31°C.

— "Worksheet 1, Egg-cetera" allows students to discover the various stages in the life cycles of chickens, ducks, turkeys, peacocks, and pigeons.

Answers — chicken: egg, chick, cockerel and pullet (male and female less than one year old), adult (rooster and hen).
duck: egg, duckling, adult (drake and hen)
turkey: egg, poult, adult (tom and hen)
peacock: egg, adult (peacock and peahen)
pigeon: egg, squab, adult

— Pages 52 to 59, The beginning of a life cycle, can be read and discussed.

— Onion cells can be observed under a microscope. See page 52.

— A worksheet is available for the "Finding Out" on page 59 in the ACTIVITIES FOR EXPLORING SCIENCE book (Page 10).

— Your class could study the various stages of embryological growth of a chicken by incubating one dozen fertilized eggs. It is wise to incubate more eggs than you expect to hatch because some will not hatch. The chicks should hatch in 21 days. All the eggs should be tested for fertility on the 7th and 14th day of incubation by candling them. Any embryo that has died should be removed immediately. An egg could be opened every three days for 15 days. Coloured charts of the various stages can be prepared by the students. You will require a brooder for the hatched eggs.

— "Activity Card 3, Staging an Egg Holdup" encourages students to design an egg candler. Encyclopedias often provide instructions. (However a beam of light from a film or filmstrip projector makes an excellent egg candler — they simply hold the egg up to the light).
Students can make their own brooder. There are a number of resource books that describe how to construct a brooder.

— Research could be undertaken to find out how many eggs are laid per year by

chickens (up to 350)
pigeons (2-4)
lizard (12)
oysters (500 000 000)
salmon (3 000)
gulls (4)
sturgeon (7 000 000)
toad (6 000)

These are approximate numbers.

— Pupils would enjoy reading Ogden Nash's poem, The Egg. After reading the poem, eight volunteers could be divided into two teams to discuss the question: "Which came first — the chicken or the egg?". Each team could have 3 minutes to present their views. The audience is then free to add ideas. Finally a vote could be taken to determine if the class thinks that the egg (or the chicken) came first.

— "Activity Card 4, Egg-citing Ventures," asks students to choose at least 5 of 13 activities related to eggs. The pages of this card can be attached and placed on a science bulletin board. An alternative would be to cut out the printed sections on each egg and deposit the activities in 13 white plastic eggs (nylon holders) and place in a big nest of straw or shredded green cellophane.

— "Activity Card 5, Raining Easter Eggs" provides some seasonal activities for this unit. Students choose 3 of the 9 activities.

- "Activity Cards 6 and 7, Luscious Strawberries, and Spuds, Taters and Potatoes" provide examples of regeneration.

  Answers to Luscious Strawberries:
  1 Answers may vary
  2 No. Some flowers do not have stamens and therefore must be planted near plants that do have stamens so that their pollen can fertilize the seeds.
  3 Because the berries seem strewn among the leaves.
  4 No. (climatic conditions will alter size of berries and shape.)
  5 Vitamin C
  6 Seeds are not surrounded by an outer skin.
- Suggested research for page 62: Statistics are showing that Canadians have a greater life expectancy now because of higher health standards and more nourishing foods. The class could discuss the future needs resulting from these causes. Some of their suggestions might include:
  - more land space required and more ways to use unproductive land
  - more food
  - more health services to care for various age groups
  - additional extended care facilities.
  - more varied recreational facilities and transportation systems for all age groups
  - more productive pastimes for retired persons to achieve fulfilment in life
  - more research related to geriatric care
  - change in retirement age
- Pages 60 to 62, Youth, Adult and Old Age, can be read and discussed.
- "Activity Card 8, Bean Sprout Farming" is an additional way to show that young plants can be produced from seeds and that the nourishment for the plant is within the seed.
- Students may record the results of the "Finding Out" on page 61 in the ACTIVITIES FOR EXPLORING SCIENCE book (page 12).

Chapter 2: Some interesting plant life cycles, pages 63-75

- Pages 64 to 66 can be read and discussed.
- See the suggested activity on page 65 about growing ferns in the classroom. In addition, pupils could examine ferns that are growing at home and relate their findings.
- Fiddleheads are the young leaves of a fern. They are harvested before they uncurl. This food is considered a delicacy. A package of frozen fiddleheads could be obtained from a supermarket, prepared and served to students. Melted butter adds to the flavour! (If fresh fiddleheads are used, it would be wise to check if that particular fern is edible.)
- A field trip to the woods will allow students to examine ferns in the natural environment. Students can record their observations on "Activity Card 9, Searching in the Woods".
- A worksheet for the "Finding Out" on page 66 is available in the ACTIVITIES FOR EXPLORING SCIENCE book (page 15).
- You may wish to have students suggest ways that moss "helps" man. Possible answers: Mosses
  - are soil makers
  - hold rain and prevent runoff
  - keep ground damp for other plants to grow
  - prevent floods by holding water to soil
  - can be used as fuel
  - can be mixed with soil to act as a fertilizer to hold moisture
  - live plants can be wrapped in it for shipping purposes
  - can be used as soft bedding in the outdoors.

  Students could demonstrate some of the above.
- "Activity Card 10, Where Did All the Water Go?" allows students to experiment with dried peat moss to discover how much water is required to restore it to its natural state.
- Pages 67 to 70, What happens in the cones?, can be read and discussed.
- A worksheet for the "Finding Out" on page 69 is available in the ACTIVITIES FOR EXPLORING SCIENCE book (page 15).
- Students could collect the male and female cones from any cone-bearing trees that grow in your area (pine, spruce, fir, hemlock, juniper and cedar). These could be labelled and displayed on cards in a science centre.
- A variety of cones could be placed in a wicker basket with information about the cones. Pupils could match the cone with the information.
- The purpose of "Worksheet 2, Tree Thoughts" is to encourage children to use critical thinking skills toward a seasonal topic — Christmas trees.
- You may wish to have pupils discuss the importance of reforestration. If logging activities are being conducted in your area, a pupil could contact the logging company to enquire about their reforestration practices. Pupils would be interested to know if your province has any specific legislation towards reforestration.
- Students could visit a forest area and examine cut tree stumps to determine the age of trees. You could pose this problem: "Suppose that a new seedling has been planted today to replace this stump. This stump is ________ years old. How old will you be when this seedling reaches the age of this stump?" This question should raise the students' awareness of how long it takes trees to reach that degree of maturity.
- Pages 71 to 75, Life cycle of a flowering plant, can be read and discussed.
- Science and social studies can be integrated if you

have pupils examine your provincial flower emblem.

- See the suggested activity at the bottom of page 71 about dandelions. Students could design their own data collection sheets. If the suggested activity extends until the dandelion goes to seed, you might want the children to conduct the experiment outlined on "Activity Card 11, Free Flight". This card proves to students that dandelion seeds can be transported distances by man and animal.
- Students could be encouraged to brainstorm ways to use the dandelion in constructive ways rather than think of the dandelion as "only a weed".
- "Activity Card 12, Busy Bees" provides instructions for the pupils to capture a bee and examine it for pollen on its body. They may also wish to examine other insects that are found on flowering plants to see if they carry pollen on their bodies. Bees should be released after the observations have been completed.
- Most country roadsides will have wild roses growing along the fences. A pupil could collect some branches and flowers and bring them to class for dissection and observation. Others could bring a cultivated rose for comparison purposes.
- The native people have made considerable use of the wild rose. They make jelly from the ripe fruit (or hips) of the wild rose and also a tea. A recipe for wild rose tea is:

WILD ROSE TEA

Remove the bark from wild rose bushes.

Peel off the inner bark. Cut this bark into tiny pieces. Place pieces into a shallow pan. Pour boiling water over the pieces.

Place pan on stove element at lowest temperature.

Let your tea "steep" to the strength you wish.

Pour into a teacup (leaving bark in pan). Enjoy!

Chapter 3: Some interesting animal life cycles, pages 76-91

- Pages 76 to 81, Life cycle of two kinds of fish, can be read and discussed.
- Films related to the life cycle of the salmon can be shown (e.g., The Salmon's Struggle for Survival produced by the National Film Board of Canada.)
- A debate could be held using this statement: "The sports fisherman is depleting the supply of salmon (or trout)."
- Students enjoy making game boards and will enjoy the challenge of creating a game for *Ol'Sam Coho*, (Activity Card 13). Prior to making the boards, a class discussion could centre around:
  - (1) the habitats of salmon during their life cycle
  - (2) the type of environment to be shown on the game board
  - (3) the spawning grounds
  - (4) hazards encountered by salmon in order to complete their life cycle.

  These topics will give them a few starting points. A prize could be offered for the most unique gameboard. Some penalty and bonus cards have been included. Pupils may wish to add others.
- Some of your pupils may have found roe in fish that they have caught. They could describe it to the class. Possibly roe could be obtained from a local fish plant. Pupils could be reminded of the delicacy caviar.
- The class could visit a local fish hatchery, if there is one nearby.
- Biologists could be invited to the class to explain their role related to the study and care of fish; a member of the local rod and gun club could also visit and explain the purposes of the organization; a sports fisherman could present his views on the present fishing regulations pertaining to your area. The students may want to have a few questions in mind to ask these visitors.
- "Worksheet 3, Concerned Biologists" provides a number of topics related to fish management. Students can be divided into small groups. The discussion could proceed in two different ways:
  - (a) The class could be divided into 5 groups and each group would be assigned a different topic. The recorder for each group would relay the ideas generated for their topic to the other groups when the class reconvenes. This procedure might take two science periods.

    OR
  - (b) Each group can discuss the same topic for a short period. After sufficient time has elapsed, all the groups could come together and each recorder would report that group's opinions to the rest of the groups. They would break into groups again and discuss the next question. This process could be accomplished in one day or over a period of several days.

  This activity was created (1) to draw students' awareness to proper fish management (2) to acquire information and opinions from community resource persons (3) to think about current situations and issues and (4) to develop public speaking skills related to a scientific topic.
- "Activity Card 14, On the Hook" allows students to examine a scale from a salmon to determine its age and the type of environment it inhabited during its lifetime. Your local fishstore could supply you with some fish scales. The scales require very careful removal as the rings are easily damaged near the edges of the scales. The scales can be kept in damp paper towels until observed. For more information, please refer to NATIONAL GEOGRAPHIC, August, 1968, *The Incredible Salmon*.
- "Worksheet 4, Salmon—Survival or Extinction?" asks students to think about the survival of the salmon, its future and salmon as an economic resource.

Possible answers for:

Card 1 — Clear cool flowing water; similar size of rocks or gravel on streambed; plants and trees (particularly deciduous ones) along stream banks.
Card 2 — Answers will vary.
Card 3 — Large rocks and logs could be removed; treat sewage before release; build fish ladders; make stream banks firmer to prevent silt build-up.
Card 4 — Red colour, Gold refers to income.
Card 7 — A salmon is a consumer because it must eat plants and marine life to survive. It is consumed by man and animals.
Card 9 — (a) we protect the salmon's environment and (b) manage our harvest.

— A worksheet for the "Finding Out" on page 81 has been provided in the ACTIVITIES FOR EXPLORING SCIENCE book (page 17).

— "Worksheet 5, The Great Tuna Caper" asks students to investigate the life cycle of the tuna and to create a scale model of this fish. Answers:

1. Higher than that of sea
2. Central Pacific: May through October
   Eastern Pacific: late winter to early spring
   Philippines: December through February
3. Squid and smaller sea animals
4. Tropical and subtropical waters in all parts of the world. In summer it travels as far north as Newfoundland and Norway in the Atlantic Ocean and as far as B.C. and Japan in the Pacific.
5. Answers will vary.

— A diorama (using a large refrigerator packing-case on its side and suspended from the ceiling) could be made to show various kinds of saltwater fishes. Pupils might like to make models of the following: cod, halibut, sardines, salmon, sailfish, mackeral, barracuda, striped bass, bluefin Tuna.

These models could be suspended from the top of the box, using fishing line, to show the depth at which they are found. Each student could research the following information and record it on a cassette tape: Characteristics of the fish, stages in its life cycle, breeding habits and unusual facts about the fish. Identification should be made on the tape to coincide with the placement of the fish in the diorama. Possible title for project: Cousteau's World, Journey into a New World, Undersea Journey, etc.

— Many fish have interesting ways to protect their eggs before they are hatched. "Worksheet 6, Fish News" lets students discover these methods. Answers:

Seahorses — Females lay eggs in a pouch on the lower side of the tail of the male. This is where they hatch.
Eels — They move from freshwater to saltwater to spawn.
Siamese Fighting Fish — Males take fish eggs into mouth as they are laid; the eggs are then blown into an air bubble nest on the water's surface. The male guards the air bubble.
Goff-Topsail Fish — After female lays her eggs, the male gathers them into his mouth.
Brook Sticklebacks — builds a nest of fibers from water plants. The eggs are deposited in nest. Male guards nest.
Pipefish — Female transfers eggs to a pouch on belly of the male. They hatch from this pouch.

— "Worksheet 7, Fish Aren't So Stupid" suggests that each student display a lucky lure, explain how it works and to tell about the catches with this lure.

— Pages 82 to 86, Life cycle of an amphibian and reptile, can be read and discussed.

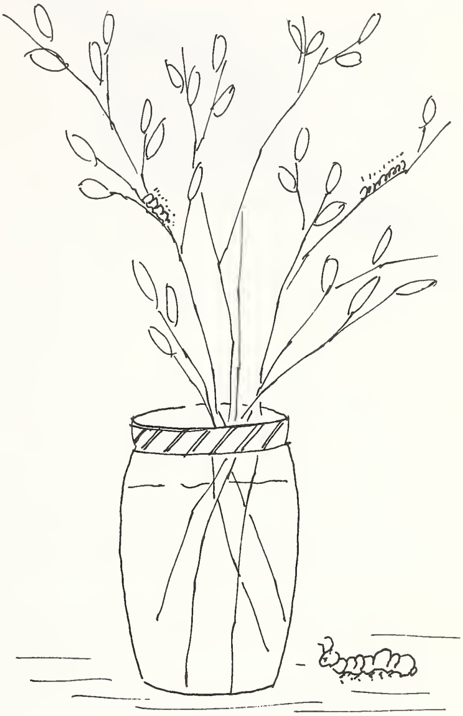
— A worksheet is available for the "Finding Out" on page 84 in the ACTIVITIES FOR EXPLORING SCIENCE book.

— If your class hatched some frog eggs, the pupils could have a Frog Race at the conclusion of this unit. Prizes could be given for the fastest and slowest frog, heaviest and lightest frogs, most aggressive frog, the noisiest frog, etc. The pupils may want to establish some rules for their contest.

— Pages 87 to 90, Life cycle of two mammals, can be read and discussed.

— You may wish to use the suggested research topics outlined on pages 88, 89 and 90 of the Teacher's Edition.

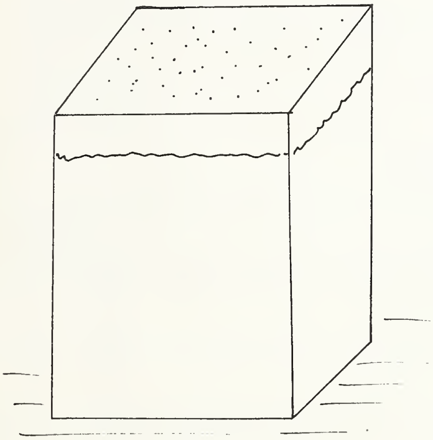
FUZZY CATERPILLARS



A caterpillar is a wormlike creature that is the second, or *larval*, stage in the life cycle of moths and butterflies. When a moth's or butterfly's egg hatches, a tiny caterpillar crawls out and begins to eat. It then forms a cocoon. The final stage is the adult stage. This is when it appears as a butterfly or moth.

- You can collect caterpillars. Be sure to save the foliage and branch where the caterpillar is found.
- Place your 'bouquet' in a jar of water and keep it fresh by cutting the stems often.
- Your caterpillar will remain on the branch and continue eating.

Caterpillars have a habit of wandering off at night! They will also wander off if they are ready to begin their transformation into a butterfly. To prevent this, build a cage for it. Here are some easy instructions:



- Get a carton. Cut one end off and cover the top with a clear plastic, punched with tiny holes to allow air to enter. Place this box over the bouquet.
- You can observe the caterpillar each day, making notes of any changes. Depending on the season, you may be able to watch the transformation of caterpillars into butterflies.

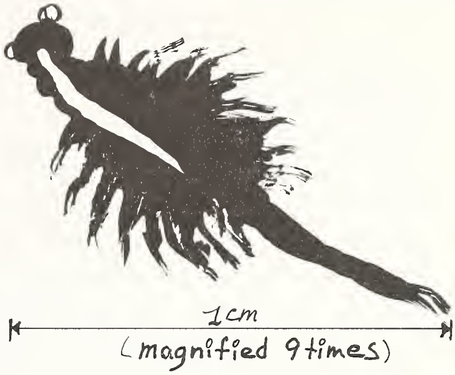
How long altogether did it take to become a butterfly?

Sometimes you can figure out what kind of caterpillar it is by identifying the kind of plant it eats. A little sleuthing might give you the answer!

Do you know how the Chinese and Japanese make silk? They us the *cocoons* of the silkworm. It's a fascinating story. Take a minute and read about it in an encyclopedia or reference book under "silkworm"!!

BRINE SHRIMP

Brine shrimp are tiny saltwater organisms. In the next several weeks you will see the brine shrimp develop from eggs to adults.



You will need: salt solution
toothpick
20-30 brine shrimp eggs
1 jar (1 L size)
1 hand lens

- Pour some salt solution into your container.
- Use a toothpick to transfer 20 to 30 brine shrimp eggs to the *surface* of the salt solution.
- Place your container where the temperature is 23° C to 28° C and where there are no drafts and no direct sunlight.
- If you maintain the temperature noted above, your brine shrimp eggs should hatch in 1 to 3 days. This stage is called the *larva stage*.
- Obtain a hand lens and observe the eggs for size, shape and colour. Complete the observation chart each day.
- When you see the small larvae begin to swim, give them a *pinch* of yeast. (A pinch is the amount that you can pick up between your thumb and first finger.)
- You will need to feed them every few days and add salt solution to replace water that has evaporated.

OBSERVATION CHART

DAY	DESCRIPTION
#1	
#2	
#3	
#4	
#5	
#6	
#7	

Keep your brine shrimp alive for some time. You may find that the adults will lay eggs!

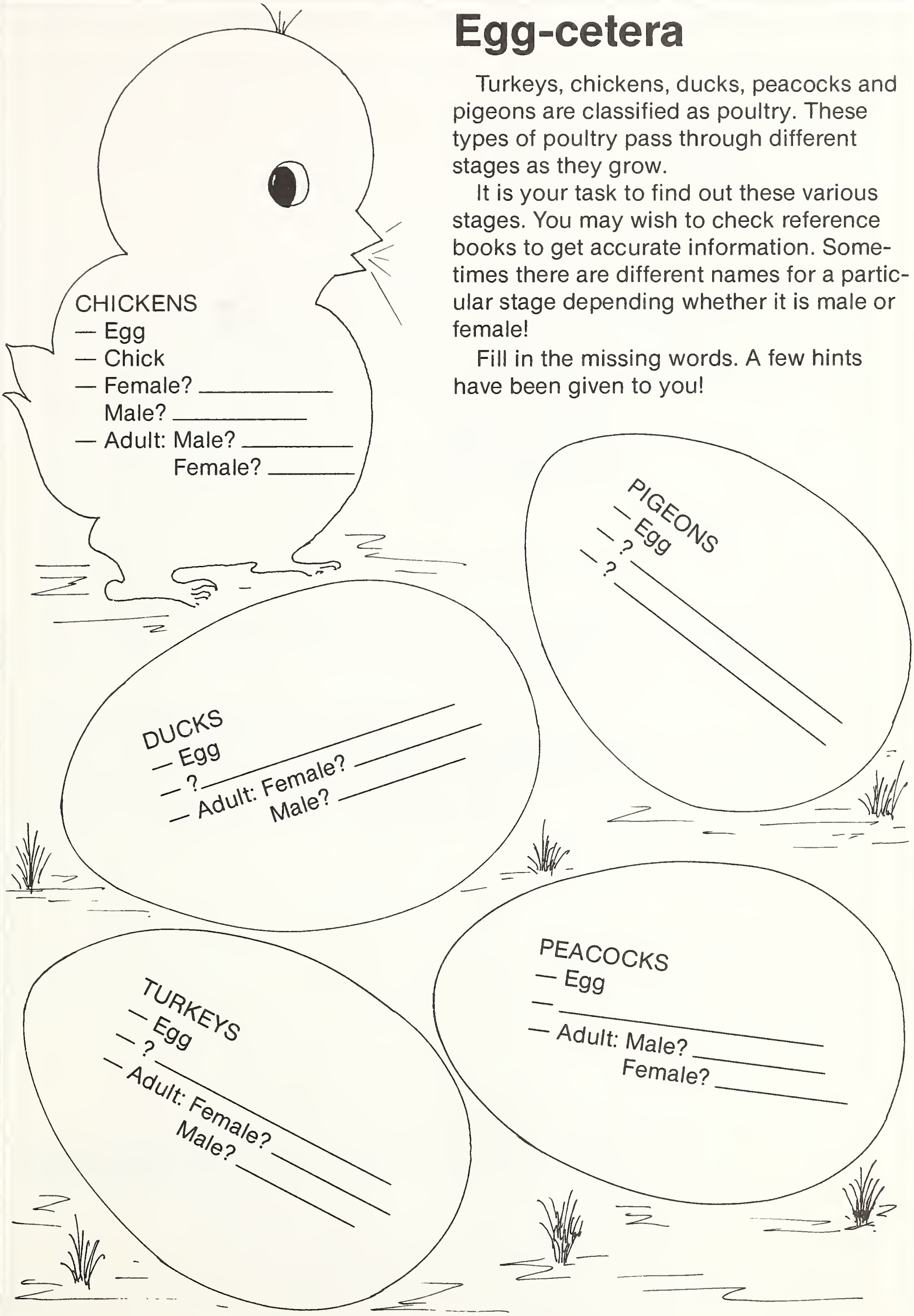
Plant and Animal Life Cycles, Activity Card 2

Egg-cetera

Turkeys, chickens, ducks, peacocks and pigeons are classified as poultry. These types of poultry pass through different stages as they grow.

It is your task to find out these various stages. You may wish to check reference books to get accurate information. Sometimes there are different names for a particular stage depending whether it is male or female!

Fill in the missing words. A few hints have been given to you!



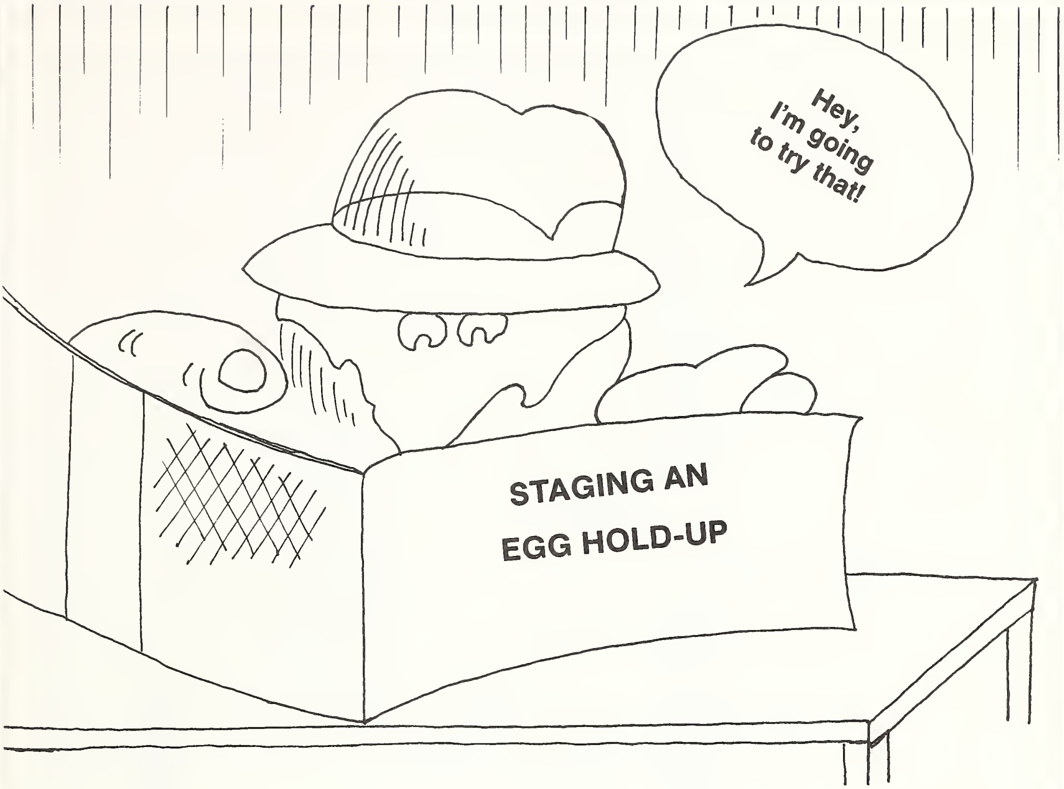
CHICKENS
— Egg
— Chick
— Female? __________
Male? __________
— Adult: Male? __________
Female? __________

PIGEONS
— Egg
— ? __________
— ? __________

DUCKS
— Egg
— ? __________
— Adult: Female? __________
Male? __________

PEACOCKS
— Egg
— __________
— Adult: Male? __________
Female? __________

TURKEYS
— Egg
— ? __________
— Adult: Female? __________
Male? __________


Hey, I'm going to try that!
STAGING AN EGG HOLD-UP

Let's get "under the table" to plan this!
It's tricky — you want to see inside an egg *without breaking the shell.*

One way that you can do it is to use a box and a filmstrip projector. How can you use these 2 items to discover what the inside of an egg looks like?

How did you set up the equipment? Make a drawing of it.

What did you see?

Try changing the position of the egg (e.g. from vertical position to horizontal). Does it look the same or different? Explain.

Plant and Animal Life Cycles, Activity Card 3

Egg-citing ventures!!

Choose at least **five** of these activities.

The Chinese preserve eggs. Find out:
— how they are preserved
— why they preserve eggs
— how long they last.

The first birds on earth are believed to have evolved from ancient flying reptiles called *pterodactylis*.

Find 4 facts about these creature's eggs and their life cycles.

Take a dozen eggs and weigh each one separately. Make a graph of your findings.

Break open an egg at home. Draw what you see. Label the parts.

Plant and Animal Life Cycles, Activity Card 4

Make an egg puzzle. Keep the clues simple to understand. Give it to a primary class to try.

Research one type of exotic bird. Do a report to explain its life cycle, its habitat and the possibility of it being raised in captivity.

Draw to scale the eggs and nests of at least three different kinds of birds.

Draw a series of eggs and show the embryonic development of a chicken from fertilization until the time it hatches. Label the different stages of development.

Make a huge egg and colour it. Record as many expressions or sayings as possible that relate to eggs. (e.g. “egg on your face”)

What would happen if .... birds did not lay eggs every year? List three possible results.

Your choice of topic — discuss your idea with the teacher. She may give you additional ideas.

Plant and Animal Life Cycles, Activity Card 4 (continued)

Find out when coloured Easter eggs came into being.

Did you know that the Persians believed that the earth had hatched from a giant egg?

Why are Easter eggs displayed at Easter time?

How do the Germans celebrate using eggs?

Who were the first to use Easter eggs?

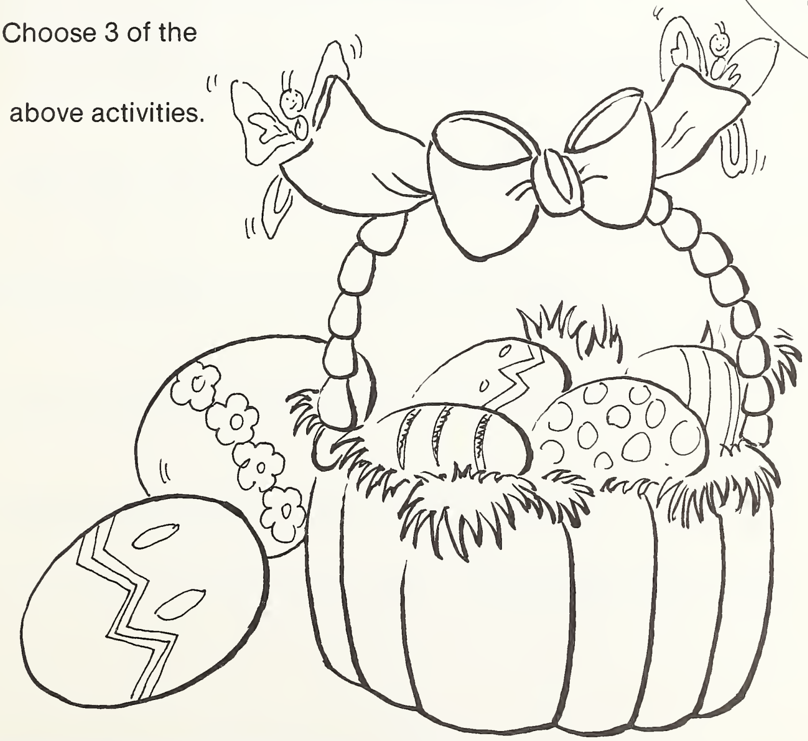
What is Pysanka? What kinds of designs are used? Draw 3 of them.

Design a Pysanka egg, using some of the symbols that the Ukrainians use. Colour it.

Write an Easter legend of your own.

Find out another country's custom of using eggs at Easter.

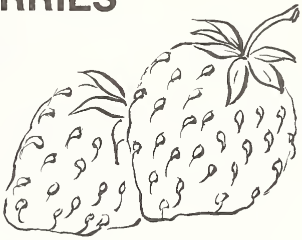
Choose 3 of the above activities.



RAINING EASTER EGGS

Plant and Animal Life Cycles, Activity Card 5

LUSCIOUS STRAWBERRIES



Some plants can produce new organisms from parts of the old plant. The strawberry is one of these plants. You are probably saying to yourself .....

"But the strawberry has seeds. It should reproduce by seeds!"

You are right, it does have yellow seeds on the outside of the fruit. However, the strawberry plant does not reproduce by these seeds. Here's how it reproduces!

When the fruit is developing, this plant sends out slender growths called *runners*. These runners, which look like string, grow on the ground and send roots into the soil. The new roots produce plants which grow and bear fruit.

Perhaps your parents have grown strawberries in the garden. Have you seen them dig up these small plants and replant them elsewhere?

Would you like to grow your own strawberries?

- Plant a strawberry plant in a large pot. Use rich soil (a combination of soil, peat and a small amount of sand).
- Watch it grow. When little runners appear, poke them back into the soil.

Enjoy your strawberries! Share them with some friends.

Questions to answer:

1. Do all strawberries have the same number of seeds? (If you're not sure, count them.)

2. Does every strawberry produce a strawberry? Why?

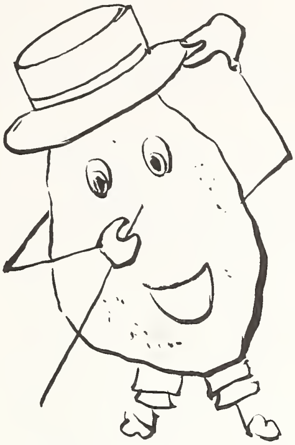
3. This plant first had the name strewberry. Find out why.

4. Are all strawberries the same shape? Why do you think so?

5. Strawberries are a good source of Vitamin ___________.

6. The strawberry is not a true berry. Check a reference book to find out why.

Plant and Animal Life Cycles, Activity Card 6



SPUDS
'TATERS
POTATOES

Potatoes are referred to as *tubers*; these tubers are the edible part of the potato plant that grows in the ground. Usually 3-6 tubers grow on one plant. The potato is called an 'annual' and must be planted each year. That is, the plant will die naturally each fall when the tubers mature. The potato requires 90-120 days to reach maturity.

Potatoes can be grown by 2 methods: reproduced by seed or reproduced from the bud parts of the tuber. The last method of reproduction is called *vegetative reproduction*. This is the most commonly used by vegetable gardeners. Bananas, pineapple and asparagus also can be reproduced by vegetative reproduction.

The potato grower will take a potato and cut it into pieces. Each piece must have at least one "eye" or "bud". You and another friend can grow your own potato plants. Here's how! It's easy!

You will need: a potato with 3 or 4 buds on it for each person
soil containing some very small stones or sand
knife
2 large pots or buckets (18 cm deep)
water
2 plastic bags and twist-ties
fertilizer

- Cut your potato into two sections (each section having 1 or 2 buds).
- Place about 8 cm of soil in pot. Place one of the potato sections on top of the soil. Sprinkle a little fertilizer on the soil around the plant. Cover the plant with soil within 1 cm of top of pot.
- Sprinkle water over the soil. Watch it grow! Your plant will have to be watered each day to keep the soil lightly moist.

********** **********

- Examine the other section of your potato. Draw a picture of this section showing details. Label any details.

- Describe the "bud".

Spuds, ’taters and Potatoes Page 2

- Place this section in a plastic bag and close it with a twist-tie. Place it in a fairly dark place. Let it grow for 3 or 4 weeks. Check it each Monday, Wednesday and Friday and record your findings.

WEEK	LENGTH OF BUD	COLOUR	DESCRIPTION
WEEK 1 M			
W			
F			
WEEK 2 M			
W			
F			
WEEK 3 M			
W			
F			
WEEK 4 M			
W			
F			

- Hopefully your potato changed in the four weeks. What was the most spectacular change?

- What other changes occurred, if any?

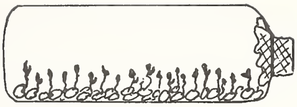
- Why do you think it grew, even though it was not planted in soil?

- Do you think that you could continue to grow this plant, as is, to maturity? Explain your answer.

- Draw a picture to show the details of this section now.

Plant and Animal Life Cycles, Activity Card 7 (continued)

BEAN SPROUT FARMING!



You will need: 150 mL of untreated mung beans
measuring cup
two 1 L jars
a bowl
lukewarm water
knife, 2 rubber bands
2 squares of cheesecloth (each 15 cm square)

- Carefully sort through the beans, removing any imperfect ones. Wash them thoroughly. Place the beans in a bowl and cover them with lukewarm water. Allow enough water for the beans to swell. (They will nearly double.) Let stand overnight.
- Drain, then rinse the beans thoroughly. Set aside four of the beans.
- Place half the beans in one jar. Place the others in the other jar. Cover the tops of the jars with cheesecloth and fasten with rubber bands. Place the jars on their sides so that the beans form a layer.
- Store in a warm, dark place (20° C to 25° C).
- Once a day rinse the sprouts by pouring lukewarm water into the jars. Swirl the jar to moisten all the beans. Pour off the water. Sprouts are ready to use in about three or four days. Optimum sprout length is 1.5 to 4 cm.
- Observe the remaining four beans. Measure and record their size. Describe what you see and draw what you observe on the chart below.

	BEAN#1	BEAN #2	BEAN #3	BEAN #4
SIZE				
DRAWING				
DESCRIPTION				

Plant and Animal Life Cycles, Activity Card 8

Bean Sprout Farming Cont'd.

- Record the size of the *average* bean each day:

_____ DAY 1 _____ DAY 2 _____ DAY 3 _____ DAY 4

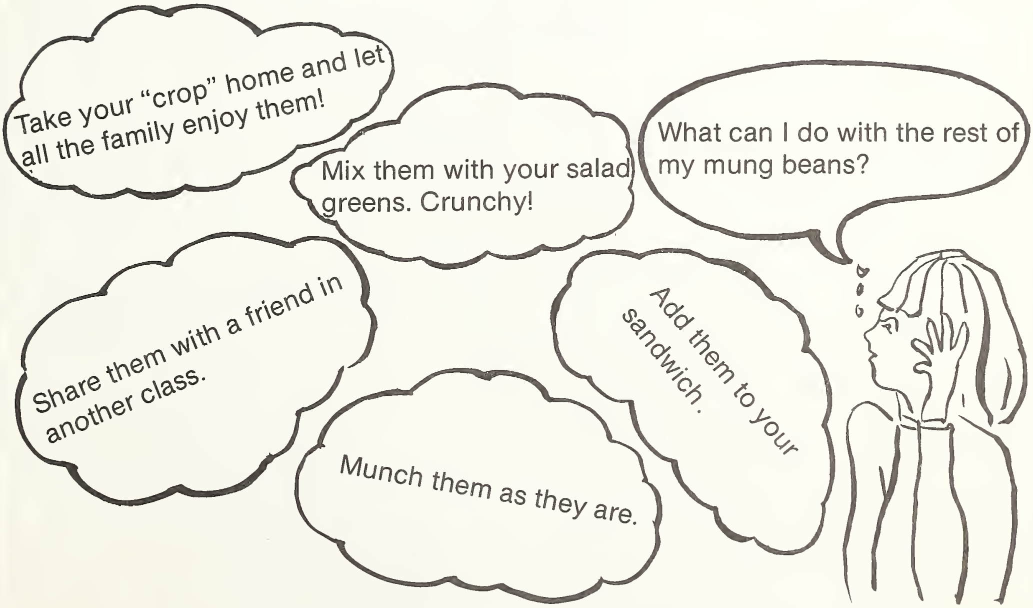
- Carefully open one of the "sprouting" beans each day. Make a drawing showing its actual size. Describe the physical characteristics of the 'sprouting bean'.

What major changes did you notice over the period of four days?

Do you think that all the beans change in the same ways?

Open a bean to confirm or disprove your theory. What did you find?

- Try to grow alfalfa sprouts! Check to see how alfalfa sprouts are grown. Follow the same inquiry processes as above. Record your findings.


Take your "crop" home and let all the family enjoy them!
Mix them with your salad greens. Crunchy!
What can I do with the rest of my mung beans?
Share them with a friend in another class.
Add them to your sandwich.
Munch them as they are.

Plant and Animal Life Cycles, Activity Card 8 (continued)

SEARCHING IN THE WOODS

You have been studying the life cycle of the fern in your class. This is an opportunity to observe ferns growing in the natural environment and then to bring one of these plants into the classroom. You might see changes in the plant over a long period of time. Work with three other friends.

Your group will need: 1 shovel
4 ice cream buckets
4 of these sheets

4 pencils
a tape measure

- Choose an adult fern and a young fern to observe. Record the following data:

  What conditions exist around the plant (moist/dry soil, sunny/shady, types of plants, etc.)?

  Measure the diameter of the adult and young plants:

  adult: ________________ young plant: ________________

  Number of fern fronds:
  adult plant: ________________ young plant: ________________

  General description of fern plant:

  Any spore cases evident? If so, are they open or closed?

  If spore cases are open, what has happened?

- Draw a picture of the ferns that you studied:

Plant and Animal Life Cycles, Activity Card 9

- Collect a young fern plant. Place the plant in your ice bucket and pack soil around it.
- Try to find dry spore cases that are ready to open.
  Fill your flower pot with moist soil.
  Gently break the spore case so that the spores fall into the palm of your hand.
- Observe these spores. Describe them.
- Brush the spores onto the soil in your pot. *Gently* press on the soil.
- Return to the classroom with your adult plant and the pot with spores in it. To have healthy plants, you will need to maintain the moisture in the soil of both containers, similar to that of its natural environment.
- Design an observation sheet to show the changes in the two pots.

Plant and Animal Life Cycles, Activity Card 9 (continued)

TREE THOUGHTS

Do you think that reforestration is necessary in areas where logging has occurred?

What are the pros and cons of the "living" Christmas trees?

What are the pros and cons of the artificial Christmas trees?

Christmas tree farms are becoming more common. Do you think that this is a good idea? Explain.

Why do you think that it is illegal in some areas to cut Christmas trees? Do you agree with this ruling? Explain.

Which kind of tree do you prefer at Christmas time — a tree from the natural environment or a "cultured" tree?

Does your family prefer one kind of Christmas tree to another kind? If so, what kind?

Plant and Animal Life Cycles, Worksheet 2

WHERE DID ALL THE WATER GO?

Spagnum moss is a kind of peat moss. Peat moss is the first stage in the development of coal. Canada and other temperate areas of the world grow peat moss. It is found in wet, marshy areas called peat bogs.

As the moss' roots and leaves grow, they eventually become so numerous that the plants die from lack of nourishment. The plants then begin to decay and form a thick mat on the surface of the marsh. Eventually, they sink into the wet ground. New moss begins to grow and this process is repeated many times. If there is sufficient heat and pressure over a long period of time, it will become coal after a few centuries.

Peat moss gets moisture through its stems and leaves. This moisture is retained for long periods of time. For this reason florists and gardeners like to add peat to their soil so that their plants will not dry out.

This experiment will let you discover how much water is required to restore peat moss to its natural state.

You will need: 250 mL dry peat moss
water
1 L container
measuring cup

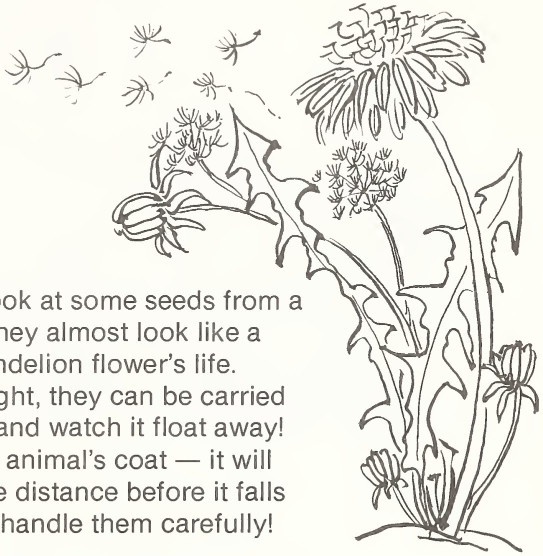
- Place the dry peat moss in your container. Add 15 mL of water and let it soak into the peat moss. Set aside for 15 minutes.
- Continue adding 15 mL of water, as above, until the peat moss looks wet. (There should not be any excess water on bottom of dish.) Keep a record of the amount of water used.

Did you notice any changes during this process?

How much water did you use to restore the peat moss to its natural state?

Do you think that you could grow plants on peat moss? Try to grow some seeds on the wet peat moss! Have fun!

FREE FLIGHT



On your way home today, stop and look at some seeds from a dandelion plant. Have a look at them. They almost look like a parachute! This is the last stage of a dandelion flower's life. Because of their structure and light weight, they can be carried long distances by the wind. Let one go and watch it float away!

These seeds also can get stuck on an animal's coat — it will stick and travel with the animal for some distance before it falls off. Take some seeds home with you — handle them carefully!

- When you go home, ask if you can take your dog (or your neighbour's dog) for a walk. If you can, take a clock or watch with you.
- As you leave your yard, stick a seed on your dog's head and back. Also stick two seeds on your sweater or coat. Note the time that you do this.
- Record the time here ____________________.
- Walk along together and watch these seeds. If one floats away, note the time and try to follow it until it lands. Observe the others in the same way.
  Seeds on the dog flew away at ____________________and____________________.

  Seeds on my sweater flew away at ____________________and____________________.
- Make a map of the area (from your home to the dandelion's landing site).
- How long did it take the first seed to fall off?
- How long did it take the last seed to fall off?
- Which took longer to drop off, the seeds placed on the dog or the ones on your sweater?
- Why do you think that it took them longer?
- Do you think that those seeds will germinate and begin a new life cycle? Explain your reasons.

BUSY BEES

One of the most common carriers of pollen are bees. They collect nectar from flowers for food as well as collecting pollen for food. The pollen can be carried by the bee in two ways:

(a) The pollen collects in small cavities on their hind legs and
(b) the pollen sticks to their bodies and is carried to other flowers.

You can observe these grains of pollen being carried by bees if you conduct this experiment:

You will need: 1 L jar with lid
1 hand lens

- Try to find an area where bees are. These might be in a flowerbed, a flowering bush or tree. Watch your step. Please do not step on the flowers!!
- Trap a bee in your jar. Cover it. Carefully remove one or two flowers from the plant where you found the bee. Place them in your jar too.
- Take your jar back to the classroom. Using your hand lens try to find pollen on the bee's legs or body.
- Do you think that you could find other insects that carry pollen on their body? Go on an insect safari! Collect different types and examine them for pollen.
- Draw pictures of the bee and other insects that you have found. Indicate where you found pollen on them.

- Release the bee and any insects into the environment when you have finished with this activity.

Plant and Animal Life Cycles, Activity Card 12

Ol' Sam Coho says: "Create a game to make people aware of all the hazards, as well as the good things, that happen to me in my lifetime! You can work with a friend if you wish."

Here are a few hints to help you to get started:
— How many people can play?
— What directions will they need?
— Will you need dice?
— What will you use for playing pieces?
— Will you use penalty and bonus cards *or* will you print the penalties and bonuses on the gameboard?
— What is my habitat like?
— Where are my spawning grounds?

Have fun!

Penalty and Bonus Cards

OL' SAM COHO

PENALTY CARDS

Dumping logs today — Lose one turn.

Ban on fishing today. Miss 2 turns.

Oil spill kills school of fish. Go back 3 spaces.

Rough seas ahead. Miss 1 turn.

Eaten by bear. Go back to GO.

Caught by fisherman. Go back to GO.

Herring fleets fishing. Lose 2 turns.

Log jam. Miss 1 turn.

Tired. Miss 1 turn.

Eggs disturbed. Go back to GO.

Bears present! Lose 1 turn.

Seals present. Go back 2 spaces.

BONUS CARDS

Plankton plentiful. Advance 2 spaces.

Big herring run. Advance 2 spaces.

A school of fish present. Advance 1 space.

Clear water. Advance 2 spaces.

Ideal streambed. Advance 4 spaces.

Stream replenished. Take another turn.

I've had a rest. Move 1 space.

Good fish management. Move 1 space.

Escaped from fish hook. Move 2 spaces.

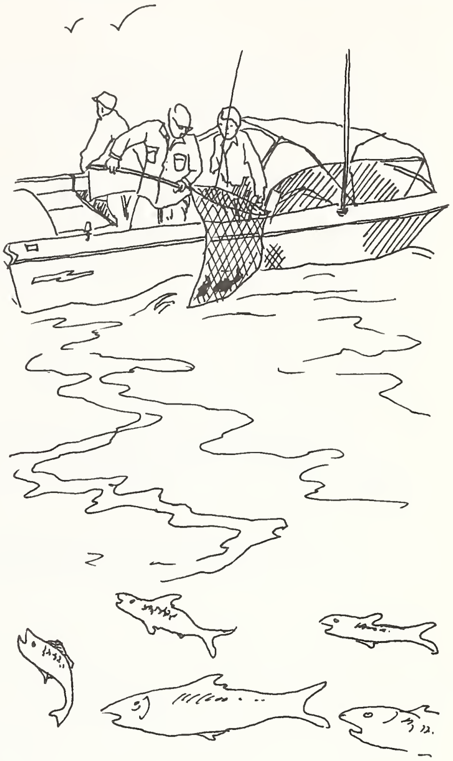
Raised in a fish hatchery. Move one space.

Avoided two fish hooks. Move 2 spaces.

On my way upstream. Move 1 space. If going downstream, lose a turn.

Plant and Animal Life Cycles, Activity Card 13

CONCERNED BIOLOGISTS



Biology is the science of living things — plants and animals. A biologist is a scientist who studies living things. Biologists often are asked to speak to community groups about the most desirable methods of preserving plants and animals. They are also concerned about the maintenance of adequate fish populations. If too many fish, and the food supplies, are taken from the lakes and oceans, the degree of reproduction will be less. Eventually, a fish could become an endangered species!

In this activity, you and a friend will assume the role of Concerned Biologists. The public (i.e. the class) has requested you to present your views on the topics listed below. To help you to prepare your presentation, ask the opinions of: your parents, sports fishermen, fish hatchery personnel, commercial fishermen, your neighbours, biologists, public health official, a fish and game warden and personnel from federal and provincial fish and wildlife departments.

Explain to them that you are studying the life cycle of fish and that you have a project related to the maintenance of fish populations. Mention the topic that you have chosen and ask them if they would mind giving you their opinion on this topic. Be sure to thank them for sharing their ideas with you. They will be pleased that you are giving thought to such important issues!

Choose ONE of the following topics:

- The advantages and disadvantages of raising fish eggs in a fish hatchery versus the natural environment.
- The importance of limiting the number of fish caught by the sports fisherman and controlling commercial "catches" (i.e. the number caught and the area).
- The advantages and disadvantages of harvesting large catches of herring at one time.
- The purpose of "tagging" fish.
- The role that the salmon play as one of Canada's natural resources.
- Should other countries be allowed to purchase large quantities of herring from local fishing fleets?
- Should caviar 'lovers' forego such tasty morsels?
- A tanker 'spillage' occurs in the Great Lakes. What fish will be affected and how will they be affected?
- Should mines be allowed to dump their wastes into streams, lakes, rivers or oceans? Why? Why not?

Plant and Animal Life Cycles, Worksheet 3

Concerned Biologists (continued)

- A camper dumps a large can of kerosene and a large can of liquid barbecue lighter fluid in a local lake. What are the present penalties for such an offence? Do you think the present penalty is adequate? Explain.
- A factory wanted to get rid of chemical wastes and so they were poured into a drain and eventually reached the local lake. Dead fish began to float on the surface; water samples were taken. The chemicals were traced back to the factory. The usual penalty is a fine but the officials have found fines to be an ineffective deterrent to these practices. What more effective measures could be taken?
- Explain the regulations for fishing in your area.
- Do you think that visitors from other countries should receive the same privileges regarding the numbers of fish caught as Canadians?
- The city planning department has decided to open a new housing development. This project will divert the river. However spawning fish use this river to get to their spawning grounds. What would you advise the planning department to do so that it would not disrupt the life cycle of these fish?

Your presentation should take about two minutes. This should not be difficult if you have researched your topic, thought about your topic and asked the opinion of others!

Plant and Animal Life Cycles, Worksheet 3 (continued)

SALMON

Survival or Extinction?

1. What conditions do you think are important for salmon eggs to survive?	2. It has been said that man has destroyed some of the spawning beds. Do you think this is true? Explain your view.
3. Think of 3 ways that man could protect spawning beds.	4. Salmon is often referred to as "red gold". Why?
5. Suppose a biologist crossbred a coho and a sockeye. Describe what its physical characteristics might be. (Check research books to find the characteristics of the present species.	6. Draw a cartoon of a salmon approaching a fisherman's lure. What is the fish saying to itself?
7. "The salmon is a consumer and is consumed." Explain this statement.	8. Draw a salmon's food web.
9. Complete this statement: "Salmon are an unlimited natural resource as long as	10. How can YOU, as an individual, protect the life cycle of the salmon?

Plant and Animal Life Cycles, Worksheet 4

ON THE HOOK . . .

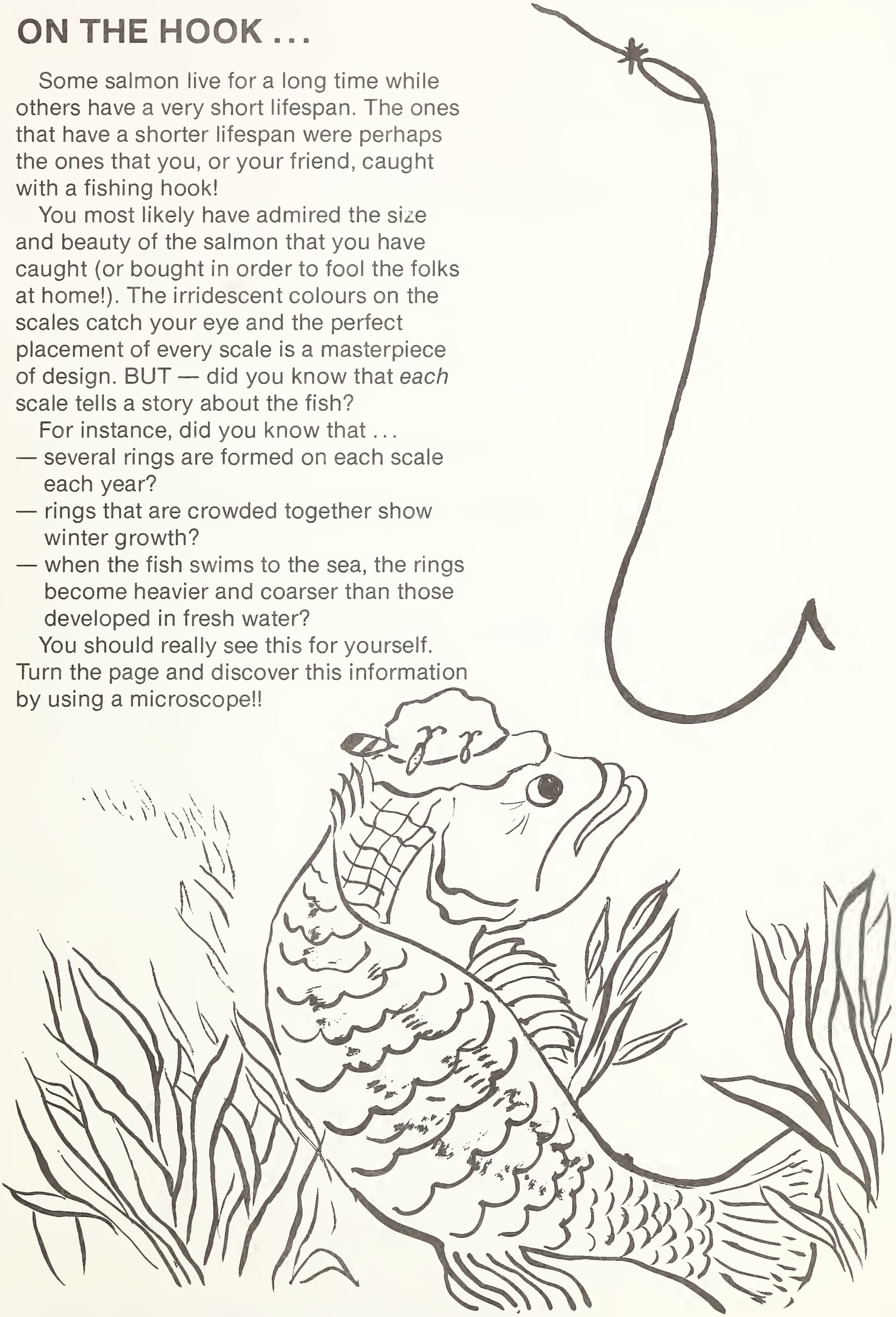
Some salmon live for a long time while others have a very short lifespan. The ones that have a shorter lifespan were perhaps the ones that you, or your friend, caught with a fishing hook!

You most likely have admired the size and beauty of the salmon that you have caught (or bought in order to fool the folks at home!). The irridescent colours on the scales catch your eye and the perfect placement of every scale is a masterpiece of design. BUT — did you know that *each* scale tells a story about the fish?

For instance, did you know that . . .

— several rings are formed on each scale each year?
— rings that are crowded together show winter growth?
— when the fish swims to the sea, the rings become heavier and coarser than those developed in fresh water?

You should really see this for yourself. Turn the page and discover this information by using a microscope!!



Plant and Animal Life Cycles, Activity Card 14

On the hook (continued)

You will need: a microscope
a microscope slide
3 fish scales (salmon)
tweezers

- Very carefully remove two or three scales from a salmon, using tweezers.
- Pick up the scales with the tweezers, touching only the very edge of the scale as they can bruise the scale very easily.
- Place the scale on a microscope slide.
- Place slide under microscope. Adjust microscope so that it is in focus.

Approximately how old is your fish?

How many winters do you think it lived, according to the scale.

Was it in seawater longer than freshwater (or vice versa)?

Examine the others in the same way. Were there any differences?

Do you think that you could gain similar information if you examined a trout's or herring's scales? Try it!

What did you discover?

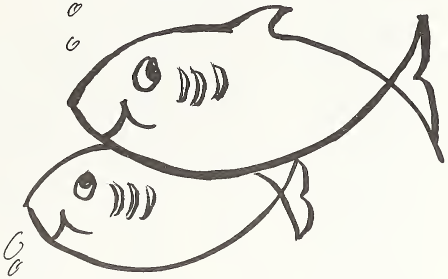
Draw a scale from a trout and from a salmon:

THE GREAT TUNA CAPER

We belong to a group of fishes. The other "groupies" are mackerals, horse mackerals and the bonitoe.

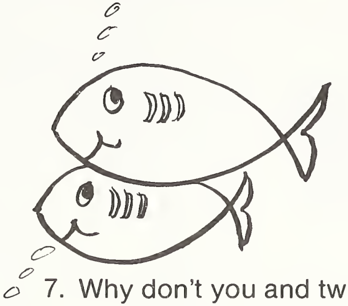
You meet me often at lunch but otherwise you may know very little about me. When you find out more about me, you will think that I am quite unique!

1. What is unique about my body temperature?

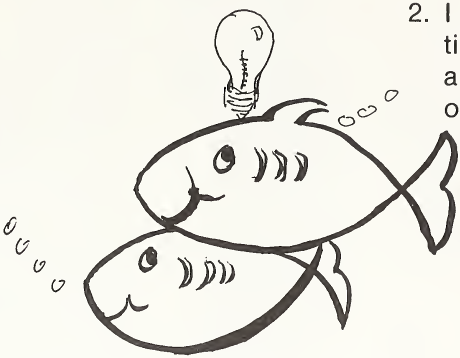


6. With 2 other friends, make a scale model of me. Guess you'll have to find out my dimensions, won't you? There goes my secret!

5. Trace what happens to me from the time I'm born until I reach your dinner table.



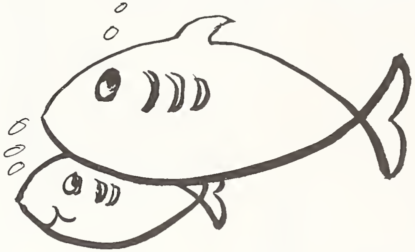
7. Why don't you and two of your friends make up a fun song about me. Perform for the class. Remember, I am big but beautiful. How will you dress like me?



2. I have different spawning times depending on "who" I am and "where" I live. Find out more about this.

3. My diet is composed of ____

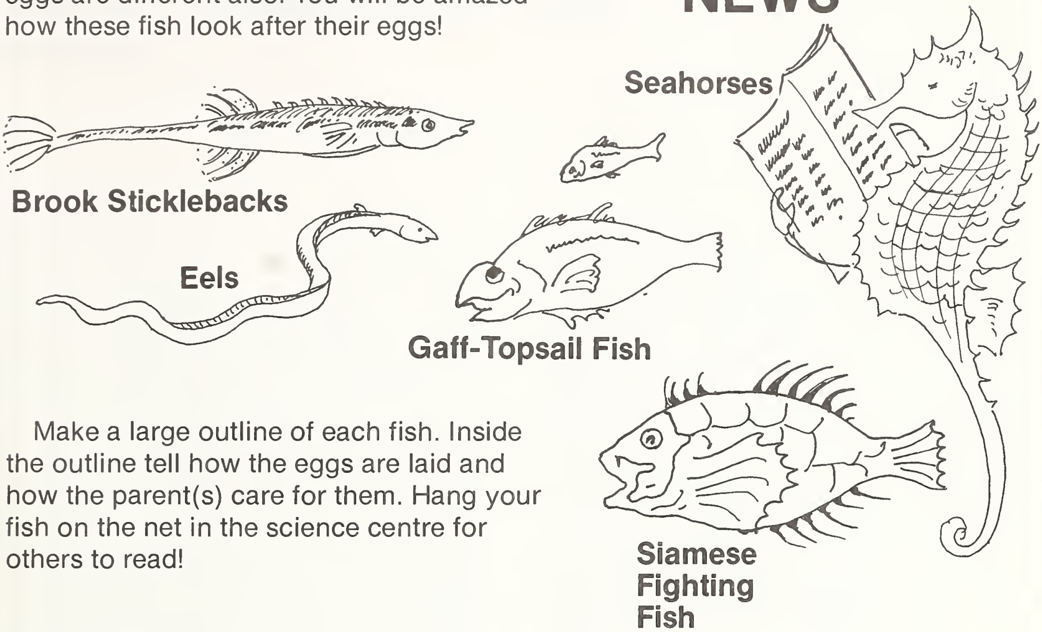
4. Where can you catch me?



8. I dislike being the filling in a sandwich all the time. What unique way could you serve me? Write down the recipe. Make it and share it with your friends.
P.S. I don't mind being eaten by you because you're a GREAT person!

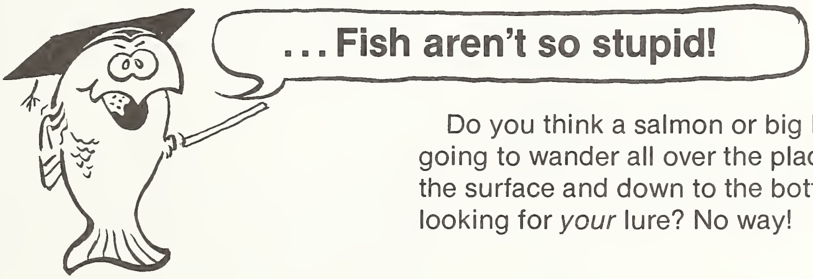
FISH NEWS

Not all fish lay eggs in a river like the salmon do. Their methods of caring for the eggs are different also. You will be amazed how these fish look after their eggs!



Make a large outline of each fish. Inside the outline tell how the eggs are laid and how the parent(s) care for them. Hang your fish on the net in the science centre for others to read!

Plant and Animal Life Cycles, Worksheet 6

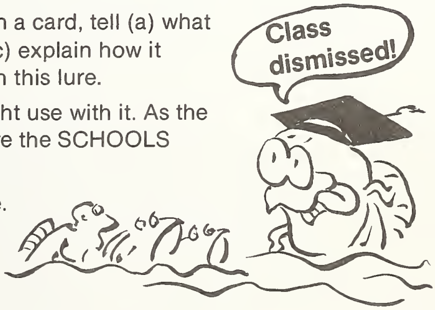

. . . Fish aren't so stupid!

Do you think a salmon or big lake trout is going to wander all over the place — up to the surface and down to the bottom — looking for *your* lure? No way!

Ol' Sam Salmon and buddies are busy in school, learning all about the "3 S's": swimming, spawning and suspicion (of un-fishy lures)!

If you want to catch fish, you have to get your lure close to where the SCHOOLS are!

- Bring your 'lucky' lure to school and let others see it. On a card, tell (a) what kind of lure it is (b) what kind of fish you catch with it (c) explain how it works in the water and (d) tell about your "catches" with this lure.
- You might also wish to display the weights that you might use with it. As the professor says, "You have to get your lure close to where the SCHOOLS are!"
- Display your lure, weight and card in the science centre.


Class dismissed!

Plant and Animal Life Cycles, Worksheet 7

RED BOOK (6)

Unit 3: Matter and You

Pages 96-143

UNIT OVERVIEW

Concept Development

In the preceding levels of the program, the following concepts were introduced and developed.

Matter is anything that takes up space. It exists in three states — namely, solids, liquids and gases. Heat energy can change the state of an object. Matter can be changed physically or chemically.

In this unit, the above concepts are expanded. Students take a closer look at matter — its structure, its properties and ways in which it can be changed to benefit people.

Unit 3, "Matter and You", consists of four chapters. Chapter one examines properties common to all material objects, and then, special properties exhibited by only some of these objects. Chapter two probes into the building blocks of matter: molecules and atoms. The third chapter discusses the elements, those pure substances made up of only one kind of atom. Chapter four explains how nature and chemists may combine or mix elements to form useful compounds or other substances.

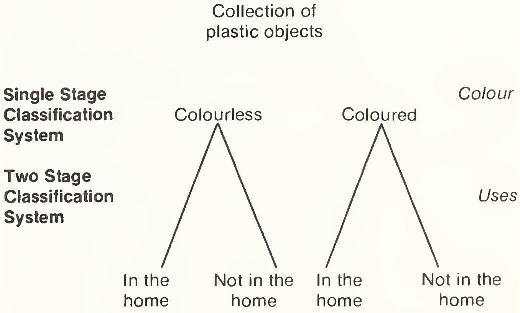
Process Development

In *observing* and *describing* the properties of matter in this unit, students use *quantitative* and *qualitative* forms of measurement. Students can describe an object, event or system in terms of qualities, such as position, location, movement or colour. These observations, however, become much more significant and useful when they are expressed in quantitative terms, by applying a standard of measure to them. For example, consider these three observations based on the "Finding Out" on page 126.

One test tube has a greater amount of gas than the other *(qualitative)*
One test tube has 2 ccs of gas, the other has 1 cc of gas *(quantitative)*
One test tube has twice as much gas as the other *(quantitative)*

The first statement is open to interpretation, because the observer's concept of "greater" is not known. The second statement is more precise, and can be understood by other people, because a standard unit of measure has been used. The third statement, although it is not as precise, can be understood in terms of the ratio expressed. The preciseness of your students' observations will depend largely on their experience with using measurement.

In the "Finding Out" (page 139) students are asked to *classify* items made of plastic. Classification is a grouping process designed to give order to collections of objects or events. Classification schemes can be used to identify and to demonstrate *similarities*, *differences* and *interrelationships* in a collection of objects or events. The grouping is based on *observable characteristics* and divides the collection into subsets which are more homogeneous than the collection. Properties such as size, colour, texture or uses may be used to sort the collections. Classification systems may be *single-stage* (one observable property), two-stage, or multi-stage, where a number of subsets are used.


Collection of plastic objects
Single Stage Classification System
Two Stage Classification System
Colourless
Coloured
Colour
Uses
In the home
Not in the home
In the home
Not in the home

Students begin the unit by *investigating* two properties of matter — inertia (page 102) and volume (page 105). They then *observe* charged electrons in the "Finding Out" on page 115. They then break down a compound (water) into its elements (hydrogen and oxygen) on page 126. This is followed by an *investigation* of the compound, rust. (page 128). The unit ends, with students *investigating* the many uses of plastics (page 139).

Related Units

Heat and Temperature	*Blue Book (3)*
Solids, Liquids and Gases	*Brown Book (4)*
Changes in Energy	*Red Book (6)*
Energy, For Work and Motion	*Exploring Matter and Energy (7)*
Science, Something People Do	*Exploring Matter and Energy (7)*

Materials and Advance Planning

The following list includes the materials that a student, or in some cases a group of students, will need to carry out the activities in this unit. In some instances, other materials may be substituted for those on the list.

Small cart or toy car; paper; small objects such as a piece of wood and a rubber ball; pencil; ruler; balloon; 6-volt battery or 4 dry cells; glass jar; 2 test tubes (or toothbrush cases); 2 pieces of covered wire; 2 pieces of aluminum foil; 2 wooden splints; 7 mL sodium sulphate (from a drugstore); matches; tape; test tube clamp; small pieces of iron (steel wool, hairpins, etc.); paper towel; drinking glass; old magazines; newspapers; scissors.

The additional activities suggested in the resource guide require: a brick; spring scale; string; heavy book; coin; drinking glass; cardboard (10 cm square); marble; 2 cardboard boxes of the same size; graduated cylinder; small hot plate; plastic tub of water; stone; pieces of wood; piece of steel; aluminum foil; waxed paper; ice cubes; empty jar with lid; coins; food colouring; dye; iodine; iron filings; sulphur; test tube; test tube clamp; magnet; alcohol burner; hammer; asbestos pad; sugar.

BACKGROUND INFORMATION

Chapter 1: Properties of matter, pages 98-111

One of the most obvious properties of solid matter is that only one solid object may occupy a given space at one time. This property is called impenetrability. Less obvious to pupils may be the impenetrability of liquids and gases. However, your pupils are quite likely to be familiar with what happens when they put a spoon into a cup full to the brim with cocoa. Some cocoa is displaced by the spoon. This is because the cocoa is impenetrable. Likewise, when a container such as a hot-water bottle is full of air, water cannot be forced into the bottle until air is let out. Air and other gases are therefore impenetrable, too.

Your pupils may also be familiar with two other properties of matter, inertia and mass. Inertia is the tendency of an object to resist motion when it is at rest and to resist stopping when it is in motion. Your pupils have probably seen someone try to move a stalled car. It is very difficult to overcome the force of inertia of the car. This is because the car has a great deal of matter in it. The amount of matter something contains is a property known as mass. If a toy car is stalled, its inertia is more easily overcome because its mass is smaller.

Matter also has weight. Many people confuse mass and weight. An object's weight is the measure of the force of gravity upon it. This force weakens as one moves farther away from the earth into space, so the weight of an object may change. However, an object's mass — the amount of matter it has — always remains the same, whether the object is on the earth or beyond it.

The amount of space an object takes up is its volume. The volume of a box can be found by multiplying its length times its width times its height. The volume of an irregularly shaped object may be found by measuring the amount of liquid it displaces when it is submerged.

Another property of matter is density. Mass alone is not enough to tell one kind of matter from another. The density of matter is very important in distinguishing between different kinds of matter. Mathematically, density can be expressed as the ratio of the mass of an object to its volume. If one kilogram of feathers takes up 8 000 cm^3 of space in a box, the density of the feathers would be 1 000 g ÷ 8 000 cm. The density of the feathers would therefore be 0.125 g/cm^3. If one kilogram of rocks takes up 125 cm^3, the density of the rocks would be 1 000 g ÷ 125 cm^3. The density of the rocks would therefore be 8 g/cm^3.

Some kinds of matter have special properties that set them apart from other kinds of matter. For example, some kinds of matter have colour; others do not. In addition to those mentioned in the text, there are other special properties of matter. For example, some kinds of matter, such as diamonds, are very hard; while others, such as chalk, are soft. Other kinds of matter are malleable because they are able to be rolled or pounded into useful shapes without breaking apart. Iron, aluminum, gold, silver and copper are malleable metals. Certain kinds of matter, such as asbestos, do not burn. Other kinds of matter, such as butter, melt very easily. Still others, such as alcohol, vaporize at a low temperature. In addition, some kinds of matter rust easily, while others do not.

Chapter 2: What is matter made of?, pages 112-115

All matter is made up of tiny particles called molecules. A molecule is the smallest amount of any substance that still has the properties of that substance. Only a few of the largest molecules can be seen with a very powerful electron microscope.

When a molecule of water is broken down into two simpler substances, these substances no longer have the properties of water. This can be observed when electric current is allowed to pass through a container of water. Some of the water is changed into hydrogen and oxygen. The weight of the newly formed gases equals the weight of the water that was lost. If these two gases are then exploded in a special chamber, they will turn back into the same amount that was lost before. In this way scientists can demonstrate that a water molecule can be broken down into two elementary units, smaller than a molecule. These smaller units are no longer water. The units are known as atoms.

Most molecules are made up of two or more atoms bonded together chemically. Some giant molecules may consist of several thousand atoms, as in the case of a protein molecule. Other molecules may be composed of only one atom, as in the case of helium.

An atom consists of three more-basic units known as electrons, protons and neutrons. An electron is a negatively charged particle. A proton is a positively charged particle. A neutron is an uncharged particle. Most of the mass of an atom is in its protons and its neutrons, both of which are located in the nucleus of an atom.

Chapter 3: Elements, pages 116-123

An element is a substance composed of only one kind of atom. It cannot be broken down into a simpler substance. Gold, mercury and oxygen are three examples of the more than one hundred elements that have been identified. At least fifty elements have been discovered only in the last hundred years. About fifteen elements have been made by scientists under laboratory conditions. Two of these elements, einsteinium and fermium, were first detected in the debris from a hydrogen-bomb explosion. Einsteinium and fermium were later made in the laboratory by bombarding uranium and plutonium, respectively, with nuclear particles. Some other elements produced by bombarding certain radioactive substances with nuclear particles are mendelevium, nobelium, and lawrencium.

Many of the symbols used today for the elements do not correspond to the names by which the elements are normally called. This is because the symbols are derived from the Latin and Greek languages. The same symbols are used worldwide for easy and accurate communication.

The text mentions where matter is found — in the air, in the ground, and in the water. When scientists first examined matter brought back from the moon, they may have expected to find new elements and new compounds not found on the earth. This has not been the case. Substances from the moon appear to be like those found on the earth. This may point to a common origin for the earth and the moon. Scientists are certainly looking forward to studying matter from other planets in our solar system.

Chapter 4: Recipes for matter, pages 124-139

Most of the elements on the earth are found combined with other elements. Two or more different elements can be combined chemically to form a new substance, known as a compound. The elements that make up a compound react with one another, causing each element to lose its own special properties. The compound has special properties that differ from the properties of the elements that comprise it. For example, hydrogen and oxygen are both gases. When these two elements combine chemically in one way, they form water, which has its distinctive properties. When hydrogen and oxygen combine chemically in another way, they form hydrogen peroxide, which also has different properties from hydrogen and oxygen.

Two or more elements can also form mixtures. Mixtures are found everywhere. The gases of the air are mixed and may be readily separated with the proper equipment. Metals are often found mixed with other materials in their natural state. The element aluminum, for example, may be found in the ore bauxite or mixed with several other metals. Mixtures differ from compounds in that the elements that make up a mixture are not united chemically. For this reason, the elements in a mixture retain most of their special properties. For example, oxygen mixed with other gases in air still supports combustion.

A mixture of two or more metals or of a metal and a nonmetal is often called an alloy. Brass is an alloy of copper and zinc. Nearly all the metal articles we buy are alloys of different kinds that combine the desirable, special properties of the elements of which they are made. Gold is a beautiful, but soft, metal. It is often mixed with copper or some other metal to make it harder and more durable for jewelry. Steel is a strong and flexible alloy that results from a mixture of iron and some other metals, such as manganese or vanadium and chromium. Manganese makes steel hard but pliant. Vanadium and chromium added to steel enable it to endure shock and vibration. An alloy is usually produced by melting and mixing the metals involved until a uniform mixture occurs.

TEACHING STRATEGIES

The purpose of the following activites and teaching strategies is to provide you, the teacher, with a wide variety of suggestions that can be used, together with the material presented in the textbook, to help develop the processes and concepts of this unit.

Chapter 1: Properties of matter, pages 98-111

- — Pages 96 and 97, Unit introduction, can be read and discussed. If your students studied the EXPLORING SCIENCE program previously, they would have encountered matter at the fourth grade.
- — Pages 98 to 100 can be read and discussed. A bulletin board display illustrating the common properties of matter can be started. Ask your pupils to find or draw as many examples of each common property as they can possibly find. A similar display for special properties of matter can also be started. Definitions of properties of matter developed by you and your pupils could be printed with large letters and become part of your display.
- — Pages 101 and 102 can be read and discussed. From your discussion you can develop a definition of inertia such as "inertia is the tendency of matter at rest to remain at rest and of matter in motion to remain in motion." Your class could then identify as many examples as possible to illustrate the property of inertia. You may wish to have some of these examples demonstrated. Some examples that illustrate inertia are:
  - — A car that is moving tends to keep moving until the brakes are applied.
  - — People standing in a bus tend to keep moving forward if the bus stops suddenly.
  - — It takes a greater effort to get a bicycle going than it takes to keep it going.

- —When you stir a liquid in a cup, the liquid tends to keep moving when you stop stirring.
  - —A person who runs into someone who is standing still illustrates both aspects of inertia.
  - —Wind has inertia. A person feels the wind because he or she has overcome the inertia of the moving air.
- —As your pupils do the "Finding Out" on page 102, you can have them record their finding on page 21 of the ACTIVITIES FOR EXPLORING SCIENCE — RED BOOK.
- —You may wish to provide your pupils with additional experiences by having them do the investigations on "Activity Card 1, Inertia".
- —Try asking your pupils to predict the outcome of each investigation before you begin. If their predictions are correct they probably have a good understanding of inertia.
- —When you discuss the second investigation in which the string breaks, you may wish to point out to your pupils that the top string breaks from a steady pull downward because it was being pulled both by the weight of the book and by your hand. In the second instance the bottom string should break because the inertia of the heavy book prevents the full force of your tug from reaching the upper string.
- —The investigation with the coin and the cardboard on the drinking glass shows the properties of inertia and gravity. When the snap of the fingers sends the cardboard flying, inertia keeps the coin from moving.
- —Gravity causes the coin to fall into the glass.
- —Pages 103 and 104 can be read and discussed. Students often find it difficult to distinguish between mass and weight. You may find it helpful to provide several examples of how mass differs from weight. The mass of a substance remains constant whereas the weight of the same substance will change if the gravitational attraction differs. A boy who weighs 36 kg on earth also has a mass of 36 kg. However, if that boy was on the moon, his weight would be one-sixth of what he weighed on earth. That is, he would weigh 6 kg on the moon. His mass on the moon would remain unchanged at 36 kg.
- —"Worksheet 1, Comparing Gravity, Mass, and Weight" can be used to provide your pupils with more experience with mass and weight.
- —"Activity Card 2, Mass", can provide your pupils with insight into how mass can be changed. When books are added to the box, matter is added to the box, thus increasing the mass. Pushing the boxes illustrates that as the amount of mass increases, the amount of force required to move the mass increases.
- —Page 105 can be read and discussed.
- —Page 22 of the ACTIVITIES FOR EXPLORING SCIENCE — RED BOOK can be used to record the data generated in the "Finding Out" on page 105. You may wish to include the boxes you used with Activity Card 2 when you are finding volume.
- —Additional experience with volume can be obtained by using "Activity Card 3, Volume."
- —Page 106 can be read and discussed.
- —You may find it helpful to use "Activity Card 4, Density." The activity card is related to For You To Think About on page 106. You may wish to ask your students to predict which objects will float.
- —Pages 107 to 111, Special properties of matter, can be read and discussed. This is a good time to complete the display on special properties of matter. Your display can be set up to contrast objects that have special properties of matter with objects that don't. For example, glass is brittle whereas some sheets of plastic are not. Aluminum foil has colour whereas clear plastic wrap has no colour. Metal springs have elasticity whereas metal rods do not. Copper wire is a good conductor of electricity whereas string is not.

Chapter 2: What is matter made of?, pages 112-115

- —Pages 112 to 114, Dividing matter, can be read and discussed.
- —You may wish to use an eyedropper to place the smallest drops of water on each pupil's hand. You can tell your pupils that they are holding millions of molecules of water.
- —You may find it helpful to have your students also examine a few grains of sand, salt and sugar separately. Your pupils can isolate one grain of each substance. You can point out that each grain of sand, salt or sugar contains millions of molecules. Later you can return to this example to point out that a grain of salt, which is made up of millions of molecules, has two different kinds of atoms in each molecule. A grain of sugar which is made up of millions of molecules has three kinds of atoms for each molecule.
- —Another way to make your pupils aware of the minuteness of molecules can be demonstrated using their sense of smell. Moth balls, oil of wintergreen, oil of peppermint, an onion (cut in half) or some similar substance can be used. Introduce the substance without letting your pupils see it. Ask them to raise their hands when they can smell the substance. Those pupils nearest the substance should be the first to detect and identify the odour. You may wish to point out to your pupils that what they smell is the result of the movement of molecules of the substance.
- —"Activity Card 5, The Size of Molecules" can be used to provide further meaning to the smallness of molecules.
- —Styrofoam balls can be used to make models of molecules. By using different size balls you can demonstrate the difference in the mass of the atoms. For example one large styrofoam ball joined to two small styrofoam balls by toothpicks with points at each end can represent a molecule of water (H_2O).

You may wish to have your pupils make models for the following molecules:

$NaCl$	sodium chloride (salt)
$CaCl_2$	calcium chloride
$CaCO_3$	calcium carbonate
$AlCl_3$	aluminum chloride
CCl_4	carbon tetrachloride
H_2O_2	hydrogen peroxide

Examples of each compound listed above can be displayed.

— Page 114, Smaller than molecules, can be read and discussed.

— Worksheet 2, Inside a Water Molecule, can be used to relate atoms to molecules.

— Page 115 can be read and discussed.

— The findings from the "Finding Out" can be recorded on page 23, of ACTIVITIES FOR EXPLORING SCIENCE — RED BOOK.

— You may be able to have your students experience an electrical charge on their body. When the inflated balloon has been rubbed on wool cloth, have your pupils bring the balloon close to their face without touching. If you do this in a darkened room your pupils may see, hear and feel an electric charge.

— Other things you may wish to use for the "Finding Out" on page 115 are: plastic ruler, combs, glass, plastic pens or pencils or a small fluorescent tube.

— If you suspend one of the objects such as a comb or a ruler by a thread you can use a second comb or ruler to demonstrate that like charges repel and unlike charges attract each other.

— The diagram below helps to explain how static electric charges operate. You can ask your students to draw similar diagrams to illustrate the electrical charges on other objects.

Chapter 3: Elements, pages 116-123

— Pages 116 to 120 can be read and discussed.

— "Worksheet 3, The Elements" can be used to provide your pupils with experience in recognizing some common elements. The answers to the crossword puzzle are:

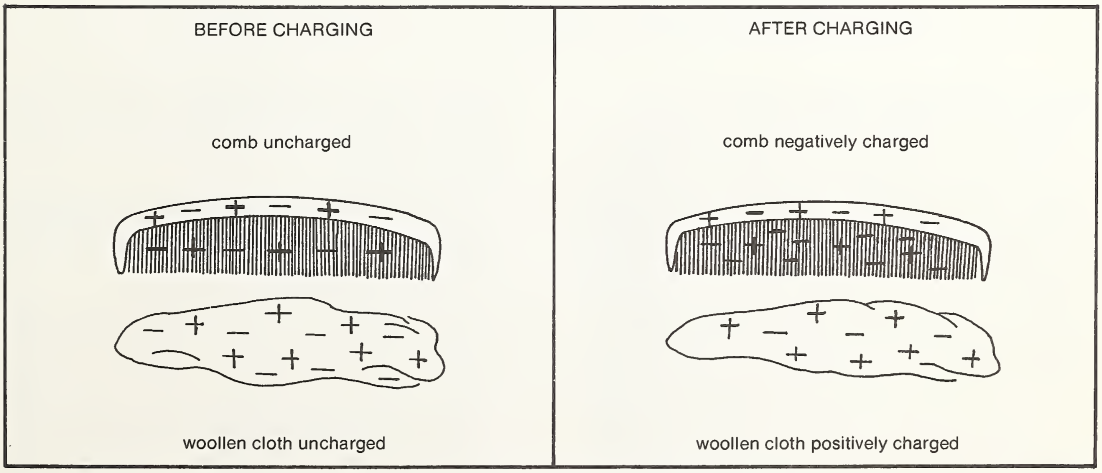
ACROSS	DOWN
1. calcium	1. carbon
2. aluminum	2. hydrogen
3. oxygen	3. mercury
4. iron	4. silver
	5. iodine
	6. gold

— You may wish to have your pupils obtain samples of as many elements as possible. A display of the elements can be set up. Samples can include a penny for the element copper, a dime for the element silver, a nickel for nickel, aluminum foil for aluminum, a mercury thermometer for mercury, and so on. When no sample of an element is available, a picture or a drawing can be used. For each element that your pupils identify, you may wish to have them try to find:

(1) the properties
(2) Where it is found?
(3) How is it used?
(4) Who discovered it?
(5) Is it a rare or common element?
(6) the chemical symbol

— If your students have encountered the Periodic Table of the Elements, you may wish to make your display of elements described above on a large chart resembling the Periodic Table. You need not include atomic weights and other technical information.

— Your display of elements could be classified under the headings metals, nonmetals and inert gases. If you use this classification scheme, you may wish to



point out to your pupils that the names of metals usually end in *ium* and the names of nonmetals usually end in *n* or ne.

— You may wish to have your pupils do research to find the meaning of atomic weight and atomic number. From their research ask your pupils to come up with a formula that will make it possible to identify the nucleus of an atom. The formula can be: neutrons + protons = atomic weight. Your pupils will need to discover that the atomic number equals the number of protons.

— When your pupils do the Exploring on Your Own on page 118 you may wish to focus their attention on elements 96, 99, and 102 which are the elements curium named after Marie and Pierre Curie, *einsteinium* named after Albert Einstein, and *nobelium* named after Alfred Nobel.

— If you wish to have your pupils become familiar with the names and symbols used for common elements you can have them memorize the names and symbols of elements listed on page 120. Additional symbols can be added at your discretion. A competition similar to a spelling bee can be used to test your pupils' knowledge. Divide the class into two teams. The teacher gives either the name of the element or its symbol. If the teacher supplies the symbol such as Ag, the pupil would be expected to provide the correct name for the element — silver.

— Pages 121 to 123, Where are elements found?, can be read and discussed.

— To extend your pupils understanding of elements you may wish to have them do research to find out what elements are found in the human body. They should find that the body is made up of carbon, hydrogen, oxygen, nitrogen, sulphur, phosphorous and calcium with traces of iodine, flourine, copper and several other elements. The research could be reported in the form of a table such as the one illustrated below:

COMPONENTS OF THE HUMAN BODY

Element	Percentage	Where the Element is Found in the Body
Oxygen	65.00%	water, carbohydrates, proteins, fats
Carbon	18.00	carbohydrates, proteins, fats
Hydrogen	10.00	water, carbohydrates, proteins, fats, stomach acids
Nitrogen	3.00	proteins
Calcium	2.00	bones, teeth, blood
Phosphorous	1.00	bones, teeth, muscles, nerves, brain
Potassium	0.35	soft tissues, milky secretions
Sulphur	0.25	proteins
Sodium	0.15	table salt
Chlorine	0.15	table salt, stomach acids
Magnesium	0.05	bones, soft tissues, body fluids
Iron	0.004	red blood cells, muscles, liver, kidneys, spleen
Manganese	0.003	?

Chapter 4: Recipes for matter, pages 124-140

— Pages 124 and 125 can be read and discussed.

— You may wish to make your pupils aware that compounds such as water can occur in three different states: solids, liquids or gases. "Worksheet 4, Water in its Three States" can be used to expand upon the students' knowledge of the behaviour of molecules.

— You can have your pupils make their own compound by using "Activity Card 6, Making a Compound."

— Pages 126 can be read and discussed and the results of the "Finding Out" can be recorded on page 24 of the ACTIVITIES FOR EXPLORING SCIENCE — RED BOOK. You may wish to ask your pupils a question such as, "How does this investigation show that water is not an element but a compound?". A sample answer could be that the electric current split the compound water into two elements: hydrogen and oxygen.

— Pages 127 and 128 can be read and discussed and the results of the "Finding Out" can be recorded on page 25 of the ACTIVITIES FOR EXPLORING SCIENCE — RED BOOK.

— As an extension to the discussion on the compound sugar on page 128, you may wish to have your students do "Activity Card 7, What's in a Compound?". To obtain the ideal results the test tube must be tilted while it is being heated. You may wish to have your students explain what happened to the sugar in the test tube when you heated it by using styrofoam balls to demonstrate what happened. Because forty five styrofoam balls are needed, you may wish to have a few students demonstrate for the rest of the class. The student's model should show $C_{12}H_{22}O_{11} = C_{12}$ plus $H_{22}O_{11}$. Your students may notice the $C_{12} + H_{22}O_{11}$ can be shown as 11 H_2O which may help them to explain the moisture on the side of the test tube.

— Pages 129 to 132, Mixing metals, can be read and discussed.

— Here is a technique which may help your pupils remember what they have read. Have one of your students read through the material once aloud. Have the students close their books while you read the material again omitting certain important words which the students write down on paper. Have the students open their books and correct their papers.

— A wall chart of metals and nonmetals can be prepared for the bulletin board. Select five or six common metals and five or six common nonmetals for your chart. Your chart can be divided into two main sections one above the other. In the upper section, list the metals vertically and the properties to the right of each metal. The lower section will contain the nonmetals and their properties.

— Pages 133 to 138, Building "new" matter, can be read and discussed.

— You may wish to have your pupils compare the materials that are in use today with materials that were used forty or fifty years ago. There may be someone in your community who is willing to come into your classroom to talk about the different materials of the present and the past. Pictures or newspaper clippings make for interesting comparisons.

— Pages 134 and 135 can be read and discussed. Your pupils may be interested to know that there are at least one thousand different kinds of glass, and that glass was man's first plastic. Research on the history of glass can be fascinating. For example, your pupils may discover that glass bottles were found in tombs believed to be 6 000 years old.

— Research can be conducted on certain special types of glass — fiberglass, safety glass, invisible glass, bulletproof glass and borosilicate glass (e.g. pyrex).

— Page 136 can be read and discussed. If you have invited a senior citizen to visit your classroom, he or she may be able to tell your pupils how soap was made in the home many years ago.

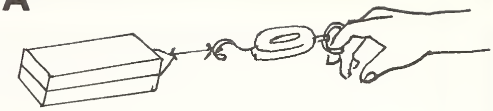
— Pages 137 to 139 can be read and discussed. You may wish to define the word plastic with your students. The word plastic may be defined to mean any substance that can be softened by heat and then molded into any desired shape. The words thermoplastic and thermosetting can provide for interesting research topics for your pupils. Thermoplastic refers to plastics that can be repeatedly softened by heating and hardened again by cooling. Thermosetting refers to material that is changed by heat into a permanently infusible solid. Plexiglas and Bakelite are examples of thermoplastics.

— Additional research topics dealing with plastics can include the following: celluloid, rayon and synthetic furs.

— Page 139 can be read and discussed. Pages 26 and 27 of the ACTIVITIES FOR EXPLORING SCIENCE — RED BOOK can be used to record the information pertaining to the "Finding Out".

— A picture dictionary can be made to serve as a review of the unit. The words identified as important words in the teacher's guide may be used. Have your pupils find a picture from magazines or draw their own. A written definition can accompany the picture.

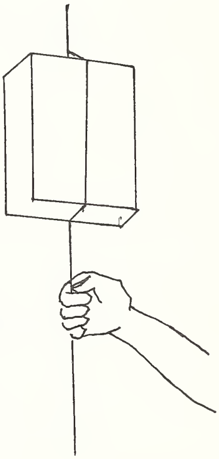
INERTIA



You will need: a brick or some similar heavy object
a spring scale or strong elastic band
string

- Tie the string to the brick and attach the spring scale as shown in the illustration above.
- Pull the brick a distance of 1 or 2 m with a constant effort.
- Try to see on the scale how much effort is needed to get the brick going compared to how much effort is needed to keep it going.
- If you use an elastic band notice how much more the elastic band is stretched to get the brick moving than it stretches to keep it moving.

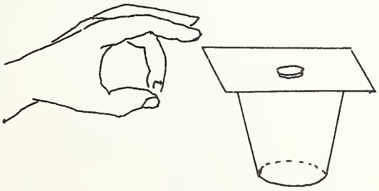
You will need: a heavy book
thin string

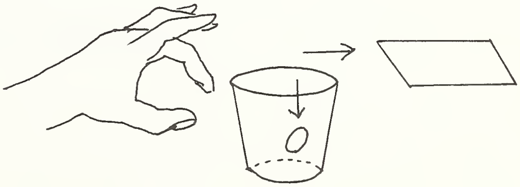


- Cut the string in two.
- Use half of the string to hang a heavy book from a doorknob or some similar object.
- Tie the other piece of string to the bottom of the book as shown in the picture.
- Use a steady pull downward on the bottom string until one string breaks. Which broke? Why?

- Tie the broken string together. Hold the bottom string loosely and then give it a strong tug. Which string broke this time? Why?

You will need: coin
drinking glass
cardboard



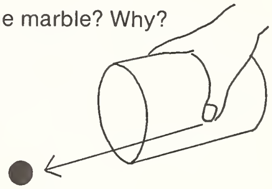


- Cut a piece of cardboard large enough to cover the mouth of the glass.
- Place the cardboard on top of the glass and place the coin on the middle of the cardboard.
- Snap your finger at the cardboard. What happens? Why?

Matter and You, Activity Card 1

You will need: marble
drinking glass or similar container

- Place the marble into the glass and gently lay the glass on its side.
- Move the glass forward in a gentle, even motion. What happens to the marble? Why?



- Gently stop moving the glass forward. What happens to the marble? Why?
- Try repeating the investigation but this time stop the glass suddenly. What happens to the marble? Why?

Matter and You, Activity Card 1 (continued)

COMPARING GRAVITY, MASS AND WEIGHT

The mass of a substance refers to how much there is of the substance. Mass is the amount of matter in a substance. The mass of a substance is its weight on earth.

Weight depends upon the amount of matter in a substance, but weight also depends upon the pull of gravity.

The same substance will have different weights in different places in the universe. The mass of a substance remains the same throughout the universe.

The chart below provides you with the force of gravity on each planet compared to the earth. Find the weight and mass of a 30 kg girl on each planet and the moon.

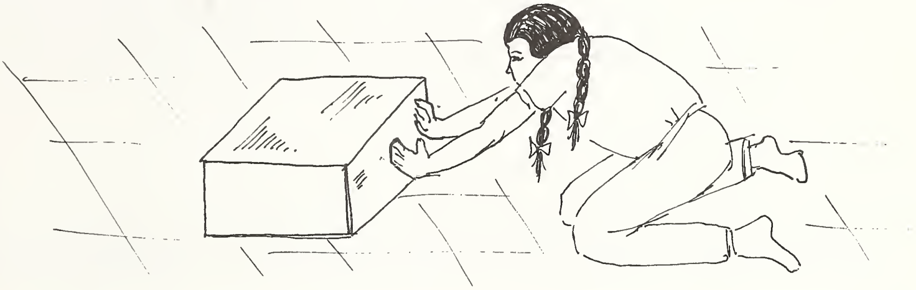
FORCE OF GRAVITY/MASS COMPARED TO EARTH	WEIGHT	
Venus 0.9	30 kg(30 x 0.9) 27 kg	
Mars 0.4		
Mercury 0.4		
Jupiter 2.6		
Saturn 1.1		
Neptune 1.5		
Uranus 1.0		
Pluto (unknown)		
Moon (Earth's) 1/6		

Matter and You, Worksheet 1

MASS

You will need: 2 boxes exactly the same size
several books

- Place the empty boxes side by side. How do their masses compare?
- Push each box across the floor.
- Place several books into one box. Now which box has more mass?

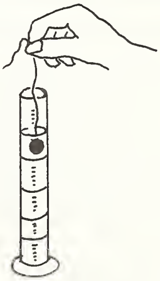


- Push each box across the floor. Which box is harder to push across the floor? Why?
- How did you change the mass of one box?
- Would the boxes have more mass on the moon?

Matter and You, Activity Card 2

VOLUME

You will need: a graduated cylinder (25 mL)
thread or string
a small stone
water



- Pour water into the graduated cylinder until it is half full. Read the level of the water.
- Tie one end of the thread around the small stone.
- Hold the other end of the thread and lower the stone into the water until water completely covers the stone.
- Read the level of the water on the cylinder. Find the difference in volume by subtracting the two readings. The difference will be the volume of the stone.

WATER LEVEL 2: ________
(WITH STONE)
WATER LEVEL 1: ________
SUBTRACT ________
VOLUME
OF STONE: ________

Matter and You, Activity Card 3

DENSITY

You will need: tub of water
stone
pieces of wood
steel
aluminum foil

waxed paper
ice cube
empty jar with lid
coins

- Predict which objects will float.
- Gently set each item onto the water. Which objects floated? Why?

- Fold the aluminum foil and waxed paper each into a ball and place the balls onto the water. What happens? Why?

- In the chart below write float or sink in the appropriate column first for your prediction and later after observing the test.

OBJECT	PREDICTION	TEST
stone		
wood		
steel		
foil		
waxed paper		
ice cube		
empty jar		
coins		

Matter and You, Activity Card 4

THE SIZE OF MOLECULES

You will need: 2 jars (about 1 L size) with lids
food colouring
ink
Easter egg dye, or iodine
water
small beaker or cylinder for measuring

- Measure 25 mL of the food colouring or other colouring substance that you have and add to a litre jar of water. Shake the jar to thoroughly mix the colour. Observe the results.
- Mark the middle of the jar and pour one half of your coloured solution into the empty jar. Keep one half jar of your solution to compare your results.
- Add clean water to your jar up to the mark. Shake it. What happened to the colour? Is there still ink in the jar? How can you tell?

- Pour out one half of the solution and add clean water. What happened to the colour? Is there still ink in the solution? How can you tell?

- Keep replacing one half of the solution and keep making the observation about colour.
- How many times can you repeat this procedure and still see colour?

- Placing a few drops of the solution on white paper will help you to see the colour as your solution becomes lighter.
- The table below will help you to see how much of the food colouring or other coloured substance is left after each pouring.

NUMBER OF POURINGS	**AMOUNT OF FOOD COLOURING LEFT IN THE SOLUTION**	**NUMBER OF POURINGS**	**AMOUNT OF FOOD COLOURING LEFT IN THE SOLUTION**
1	1/2 of 25 mL	11	1/2048
2	1/4	12	1/4096
3	1/8	13	1/8192
4	1/16	14	1/16384
5	1/32	15	1/32768
6	1/64	16	1/65536
7	1/128	17	1/131072
8	1/256	18	1/262144
9	1/512	19	1/524288
10	1/1024	20	1/1048576

The table shows that after one pouring there was one half of the original food colouring left. After two pourings there was one quarter of the original food colouring left. What fraction of the food colouring was left after five pourings? After ten pourings? After twenty pourings? Can you now assume that these liquids are made up of molecules?

Matter and You, Activity Card 5

INSIDE A WATER MOLECULE

What elements are contained in a water molecule? ____________

and ____.

If you said oxygen and hydrogen you are correct.

How many atoms of hydrogen? ____________ of oxygen?

____________.

If you said two atoms of hydrogen and one atom of oxygen you are correct.

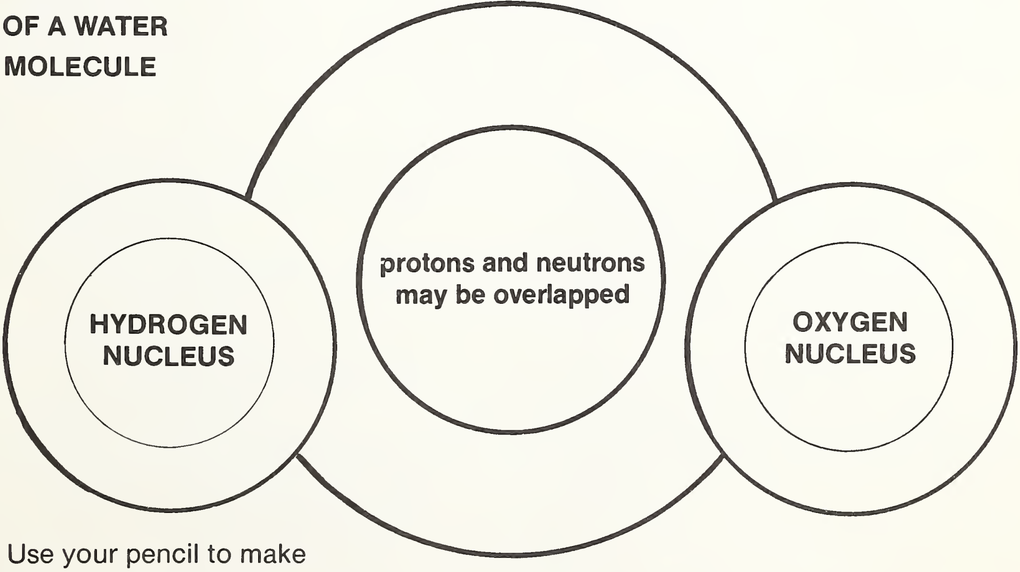
Each atom of oxygen has a nucleus which contains eight protons and eight neutrons. Each nucleus of an oxygen atom is surrounded by rings with eight electrons. A hydrogen atom has a nucleus which contains one proton and one neutron. The outside ring of a hydrogen atom has one electron.

- Cut out the circles representing the protons and neutrons and glue them onto the nucleus of each atom on the model of a water molecule.

You may wish to colour the protons one colour and the neutrons a different colour.

Protons	Neutrons
○ ○ ○ ○	○ ○ ○ ○
○ ○ ○ ○	○ ○ ○ ○

A MODEL OF A WATER MOLECULE



Use your pencil to make dots to represent electrons.

Matter and You, Worksheet 2

THE ELEMENTS

▨	▨	▨	▨	▨	1.	▨	▨	▨	▨	▨	▨	▨	2.
▨	▨	▨	▨	1.						3.	▨	▨	
▨	▨	▨	▨	▨		▨	▨	▨	▨		▨	▨	
▨	4.	▨	▨	▨		▨	▨	▨	▨		▨	▨	
▨		▨	▨	▨		▨	▨	▨	▨		▨	▨	
2.				5.				▨	▨		▨	▨	
▨		▨	▨		▨	▨	▨	▨	▨		▨	▨	
▨		▨	▨		▨	▨	▨	3.			6.		
▨		▨	▨	4.				▨	▨	▨		▨	▨
▨	▨	▨	▨		▨	▨	▨	▨	▨	▨		▨	▨
▨	▨	▨	▨		▨	▨	▨	▨	▨	▨		▨	▨

ACROSS

1. This element which is good for teeth is found in milk and other dairy products.
2. This is a rustproof, gray metal which is used in the building of airplanes.
3. This element is found in all water molecules. We also need this element to breath.
4. This is a heavy, silver-white metal that rusts easily. As humans we need iron in our red blood cells.

DOWN

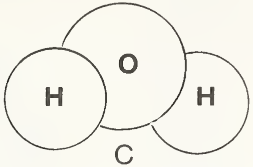
1. This is a nonmetal found as coal and diamonds.
2. This element is a flammable gas.
3. This element is found in many thermometers and is poisonous.
4. A white metal that has the symbol Ag.
5. An element used in medicines.
6. A valuable metal that has been a mark of wealth for thousands of years.

WATER IN ITS THREE STATES

The water molecule looks approximately like this:

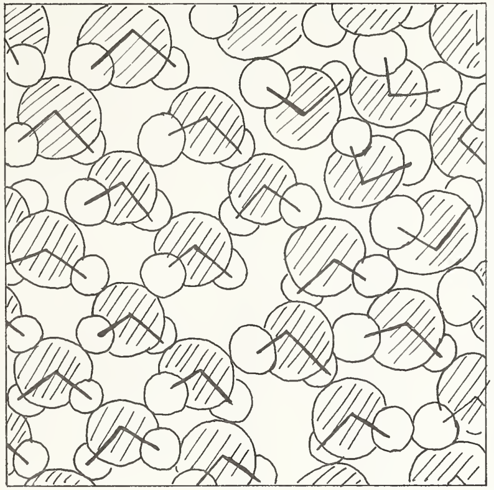
Another name for water is H_2O.

What state is each of the following:



O = Oxygen
H = Hydrogen

A

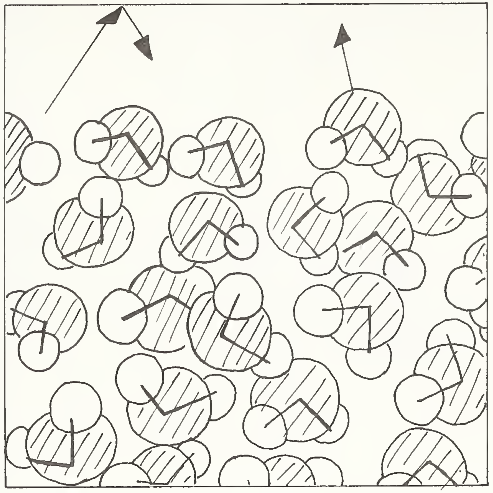


State: ____________________

What do we call the above state of

H_2O? ____________________

B

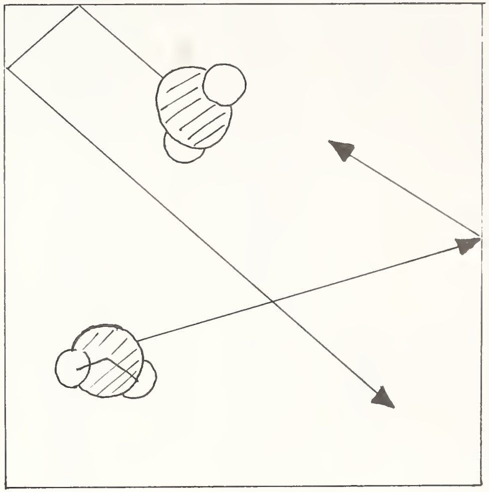


State: ____________________

What do we call the above state of

H_2O? ____________________

C



State: ____________________

What do we call the above state of

H_2O? ____________________

Why are there fewer molecules in box A than box B?

Why does box C have the fewest molecules?

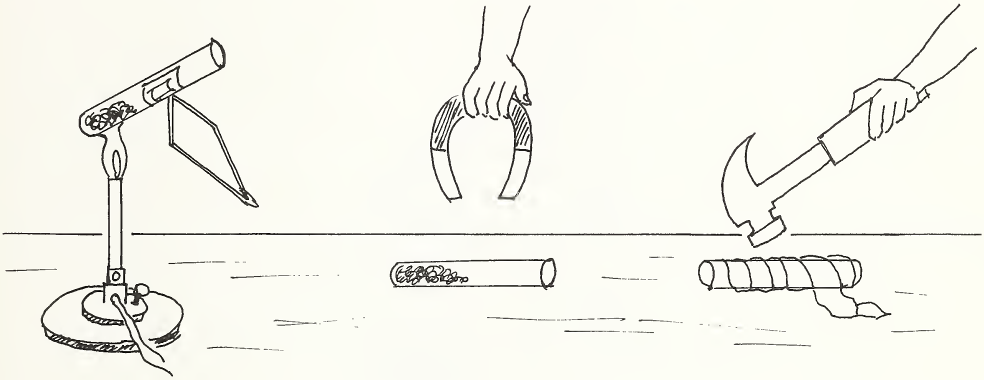
Matter and You, Worksheet 4

MAKING A COMPOUND

You will need: iron filings
sulphur
test tube
test tube clamp
magnet
burner
cloth
hammer
asbestos pad

- Make a mixture by stirring iron filings and sulphur together.
- Wrap a magnet with paper and pass it over the mixture of iron filings and sulphur. What happens?

- Heat a mixture of iron filings and sulphur in a test tube.
- Attach the clamp near the top of the test tube. Point the test tube away from you. Be careful not to touch the hot test tube.



- Set the test tube aside on an asbestos pad to cool.
- When the test tube is cool, try to remove the iron filings with the magnet? What happens?

- Wrap the test tube in cloth and carefully strike the test tube with a hammer.
- Try again to remove the iron filings with a magnet. What happens?

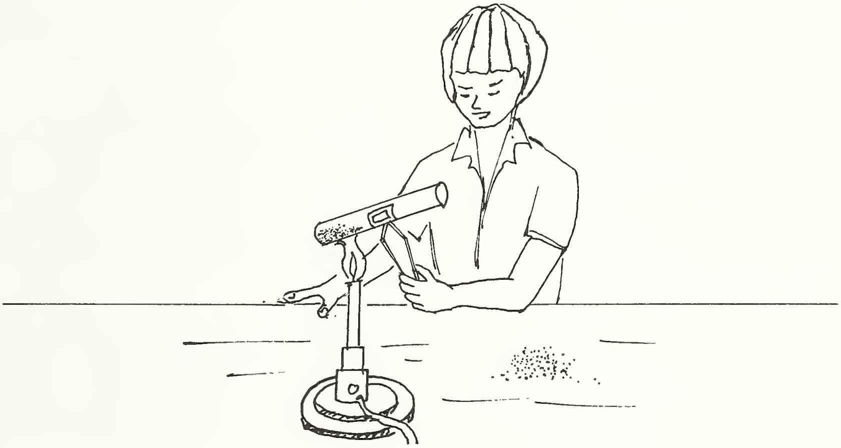
- If you have adequately heated the mixture, you will get a compound known as iron sulphide (FeS).

Matter and You, Activity Card 6

WHAT'S IN A COMPOUND?

You will need: sugar
test tube
test tube holder
burner

- Put some sugar into a test tube.
- Slowly heat the sugar over a flame. Be sure to hold the test tube at an ANGLE with the mouth of the test tube pointing AWAY from you.
- Heat the sugar until a black substance appears on the bottom of the test tube. Do you know what the black substance is? Use your textbook (page 128) to help you.
- What two elements are found in the moisture on the side of the test tube?



Matter and You, Activity Card 7

RED BOOK (6)

Unit 4: Changes in Energy

Pages 144-191

UNIT OVERVIEW

Concept Development

In the preceding levels of the program, students were introduced to a number of forms of energy, namely magnetic, radiant, sound and electrical energy. They considered how these forms of energy were produced and studied some of their properties.

Students are familiar with some of the everyday uses of the term *energy*. Yet many students at this level do not have an understanding of the scientific concept of the term. Energy is the ability of an object or system to bring about change. All physical and chemical changes involve energy. There are *sources* of energy and *receivers* of energy. For example, a gas burner (source) heating water in a kettle (receiver). The process of the interaction between an energy source and a receiver results in an *energy transfer*.

The content and activities in this unit provide a good way to develop an understanding of the concept of *interaction* between objects or systems. These interactions result in changes that can be *observed*, *measured*, *reproduced* (under the same conditions), *predicted* and *explained*.

Another important concept that should be stressed is that energy is one of our most important commodities. Without adequate energy sources, technology would not advance, and our life styles would alter considerably. Wise use and good judgement will be necessary to maintain a quality of life on this planet.

Process Development

In some of the "Finding Outs" in this unit students utilize *experimentation* skills. An experiment may be thought of as an *integrated process skill*, as it involves many of the process skills of science. Experimentation is the process of designing and carrying out procedures to obtain reliable information about interactions between objects, events or systems. You may wish to discuss with your students the procedures for an experiment. Take the "Finding Out" on page 160, for example:

1. Given a testable *hypothesis* — radio waves can be transmitted from a power source through a radio receiver.
2. Students *identify variables* (things or conditions in a system which may influence it) — power of the battery, power of the radio, distance away from the radio, direction that the radio is facing, etc...
3. Students establish *procedures* to control the variables, carry out the *investigation*, and *collect data*.
4. Students *carry out* the experiment and collect data.
5. Students *interpret their data* from their observations.
6. Students *construct a report* of their experiment indicating how their data support the original hypothesis.

Students *investigate* the use of chemical energy in making bread (page 148). They then *observe* a number of changes in energy (page 153), and carry out an activity with radiant energy (page 157). This is followed by an *experiment* involving radio waves (page 160). A simple electric generator is *constructed* in the "Finding Out" on page 163, and the unit ends with an activity to show how colour affects heat absorption (page 175).

Related Units

Magnets	*Gold Book (2)*
Heat and Temperature	*Blue Book (3)*
Sounds Around You	*Blue Book (3)*
Solids, Liquids and Gases	*Brown Book (4)*
Electricity on the Move	*Green Book (5)*
Light	*Green Book (5)*
Matter and You	*Red Book (6)*
Energy: For Work and Motion	*Exploring Matter and Energy (7)*

Materials and Advance Planning

The following list includes materials that a student, or in some cases a group of students, will need to carry out the activities in this unit. In some instances, other materials may be substituted for those on the list.

15 mL flour; 5 mL baking powder; large spoon with wooden handle; candle; small bowl; test tube; cork; test tube clamp; Vaseline; pieces of different coloured paper including gray, black, red and white; bell wire; portable radio; flashlight battery; tape; thread; compass; strong magnet; paper cup; 5 thermometers; 5 empty cans of the same size; 5 rubber bands; cardboard for can covers; measuring cup.

The additional activities suggested in the resource guide require: large empty juice can; wire screen to cover top; double sheet of newsprint; small tin to hold 75 mL of water; a thermometer; 15 mL baking soda; 6 raisins; 150 mL vinegar; 225 mL water; paper towel;

wide-mouthed glass jar; piece of wood (20 cm x 9 cm x 2 cm); 4 eyelet screws; 2 pieces of doweling (10 cm long); 4 wheels (tops of tin cans); electrician's tape; 4 thumb tacks; large elastic band; small round of wood; piece of doweling (25 cm); wood block (30 cm); 2 eyelet screws; 3 shoe boxes (or equivalent); 3 thermometers; some stones; pan of water (to fit carton); 3 small pieces of glass (to cover shoe boxes); 3 small aluminum pie plates.

BACKGROUND INFORMATION

Chapter 1: Some kinds of energy, pages 146-163

Changes in the environment occur almost constantly. For example, hillsides erode, trees are planted, houses are built, winds blow, automobiles and people move from one place to another and flowers grow. In fact, the list of events, or changes, is almost endless.

Although changes occur almost constantly, people often do not realize that every change requires energy in order for that change to take place. In fact, "energy" often is defined as the ability to produce change.

There are several kinds of energy, each of which is important to people. One kind of energy is chemical energy. The human digestive system has the capacity to chemically release the energy stored in the foods people eat. This capacity enables people to work, to stay warm, and to remain alive. Chemical energy is also released by burning substances, including gasoline and other fuels.

Another kind of energy is mechanical energy. Mechanical energy is energy of motion. A rushing river, a speeding automobile, a muscular movement of a person's arm and a vibrating guitar string are examples of mechanical energy.

Another kind of energy is heat energy. Heat energy may be produced by friction, such as when a skidding automobile tire gets hot or when a pounded nail gets warm. However, most heat energy is obtained through the burning of fuels.

Radiant energy is also a kind of energy. Radiant energy includes several different forms of energy. One form of radiant energy is visible light.

Although light is visible, there are certain things about light that no one knows for sure. For example, no one knows for sure how light travels. Scientists think, however, that light may be composed of tiny energy particles that move from place to place in ripples or waves. When a narrow beam of light is passed through a glass prism, the prism separates the light into seven different wavelengths. This separation of the wavelengths produces the seven colours of the spectrum, with red having the longest wavelength and violet, the shortest.

Unlike visible light, other forms of radiant energy are invisible. Waves of infrared energy, for example, have wavelengths that are longer than the wavelengths of visible light. Although infrared waves cannot be seen, their effect can be felt because when they strike an object, the object is warmed by the infrared waves. One appliance that gives off infrared waves is a heat lamp.

Radio waves are another form of radiant energy. Sound energy is converted into radio waves at a radio station. The radio waves are then greatly strengthened and broadcast from a radio tower. The radio waves move through the air at frequencies too high to be heard by people. However, a radio that is tuned in to one of those frequencies picks up the waves and converts them back into the sounds that people hear. Television broadcasts work about the same way except that light energy is changed into radio waves. The TV picture tube changes the radio waves back into light energy, producing a picture on the TV screen.

Microwaves are a form of radiant energy that have shorter wavelengths than radio waves. Microwaves are those that are used for cooking food in microwave ovens. These wavelengths cause the molecules in food to vibrate very fast. This movement of the molecules results in heat, which in turn causes the food to cook.

Some waves of radiant energy are shorter and more powerful than light waves. Ultraviolet waves from the sun or from sunlamps, for example, can tan or burn the skin.

X rays are shorter and even more-powerful waves of radiant energy than ultraviolet waves. In fact, X rays can pass through parts of the body and make X-ray pictures of parts of the body. X rays can also be used to kill cancer cells. Overexposure to X rays, however, may damage or destroy healthy body cells as well.

Gamma rays are even shorter and more-powerful rays than X rays. For this reason, gamma rays may be used to destroy cancer cells deep within the body. They can even penetrate thick metals and detect cracks or weak spots within the metals. As a result, metal industries regularly use gamma rays for inspection purposes.

All kinds of energy may exist in two forms, namely kinetic and potential. Kinetic energy is active, moving energy. Blowing wind, falling water, exploding gases, and a speeding airplane are examples. Potential energy is stored energy that has the ability to cause changes or movement because of its position or condition. Examples of potential energy are a large rock poised on the edge of a cliff, a wound-up clock spring, an idle but charged storage battery, gunpowder in a bullet and a chocolate bar. When potential energy is released, it becomes kinetic energy.

Chapter 2: Capturing energy, pages 164-176

Chemical energy, mechanical energy, heat energy and light energy have been used by people to some degree for thousands of years. But several kinds of energy, such as electrical energy, nuclear energy and solar energy, have required considerable knowledge and technology before they could be put to use.

Electrical energy is commonly called electricity. Electricity can be made by moving the end of a magnet in and out of a coil of wire. This movement generates a flow of electricity in the wire. This principle, though it may seem simple, is used to generate electricity at huge power plants.

Power plants may use energy from falling water or from steam to force a huge wheel to turn. A coil of wire connected to the whirling wheel continually cuts across the field of a powerful magnet. This generates electricity, which then moves through power lines.

Electricity is generated in batteries through chemical action. One kind of battery, a dry-cell battery, contains a carbon rod and a zinc lining that react chemically to a moist, acidic paste inside the battery. When a wire is connected to the battery terminals, electricity flows from the zinc to the carbon rod and through the wire. The flow of electricity stops when the wire is removed.

Another kind of battery, a wet-cell battery, contains sets of lead plates. Each set contains two plates. (Most such batteries have six sets of plates.) One plate in a set is separated from the other plate in that set by a plastic or a rubber sheet. Each plate is surrounded by sulphuric acid. The sulphuric acid reacts chemically with the lead plates, producing electricity.

Each plate is connected to one of two battery terminals, the positive terminal or the negative terminal. When a wire is attached to the terminals, electricity flows through the wire. An automobile battery is an example of a wet-cell battery.

Electrical energy can easily be changed into other forms of energy. For example, electricity flowing through a clothes dryer is changed into heat energy. Electricity flowing through an incandescent bulb is changed into light and heat energy.

Besides electrical energy, another kind of energy that has required a great deal of technology to develop is nuclear energy. The groundwork for capturing nuclear energy was laid when scientists discovered that some elements are radioactive, or give off certain types of radiant energy, such as gamma rays. Radium and uranium are two examples of elements that are radioactive.

Nuclear energy comes from the nucleus, or the centre, of an atom. Atoms of radioactive elements have unstable nuclei. ("Nuclei" is the plural form of "nucleus.") In other words, the nuclei break down spontaneously and form simpler elements in the process. For example, uranium eventually breaks down into lead, which is stable and therefore not radioactive. In the breaking-down process, however, a great deal of energy is given off.

Radioactive elements break down at specific rates. Scientists have found ways to speed up the breaking down of radioactive elements. This is done by using a nuclear reactor. In a nuclear reactor, atoms are continually split apart in what is termed a chain reaction. The speed of the reaction can be controlled so there is no explosion. The heat energy given off is used to produce steam. The steam is then used to generate electricity. Some reactors are used to power ships.

Although there are many sources of energy, the oldest-known source of energy is the sun. Such energy is called solar energy. Solar energy is responsible for the chemical energy stored in food. Through a process called photosynthesis, green plants use the energy from sunlight to make food by combining chemicals found in air and water. Some of the food made by green plants provides energy for the plants to grow. The rest of the food is stored in various parts of the plant. When people eat this stored food, their body breaks down the food and uses the chemicals for energy, growth and repair of body cells.

In recent years increased attention has been given to solar energy. For example, more homeowners are now using solar energy to heat their home and to provide hot water. A large, flat plate of glass and a plate of blackened metal may be mounted on a sloped roof that faces the sun. The glass is fitted just over the blackened metal plate to trap heat. Water pipes, also painted black, are attached to the metal plate. Sunlight heats the plate and the water circulating in the pipes. The heated water is then stored in a large tank and used as needed.

Scientists also have discovered how to make batteries powered by solar energy. A solar battery usually contains tiny silicon crystals that absorb light and change light energy into electricity. (Gallium-arsenide cells have been shown to be somewhat more efficient than silicon crystals.) One advantage of solar batteries is their very long life. For this reason they are used in space satellites.

Chapter 3: Energy in your future, pages 177-187

Because of increased standards of living and because of growing populations throughout the world, there is a steady increase in the amount of energy that is being consumed. This steady increase in energy consumption presents people with several difficult problems.

One problem is the limited supply of fossil fuels — namely coal, petroleum and natural gas. Coal is used to generate steam for power plants and to heat some factories and homes. Petroleum has many uses besides being refined into gasoline for various vehicles. Petroleum is essential for making many fertilizers, plastics, and pesticides. Natural gas is used for such things as home heating and cooking. Except possibly for coal, fossil fuels are being consumed far faster than new sources of these fuels can be found. While not everyone agrees as to when the fossil fuels may be expended, the supply is limited.

Although there are many problems regarding energy, many approaches are being used to try to solve those problems. For example, there is offshore exploration and drilling for petroleum. In addition, the search for petroleum in the Arctic has proved especially productive. Improved cooling systems in nuclear power plants are lessening the impact of thermal pollution.

Greater use of solar energy holds much promise. Some governments are encouraging the development of this almost limitless and nonpolluting energy source for home and industrial purposes.

Other natural energy sources include one that comes from pockets of hot water heated deep in the earth's crust. Steam from geysers, volcanoes and hot springs may be used to generate electricity.

Much attention is being given today to the conservation of energy. Less heat is used in homes and in factories when thermostats are turned down and when proper insulation is installed. More and more people are using public transportation rather than relying solely on automobiles. Speed limits have been reduced to lower gasoline consumption in motor vehicles. Energy conservation measures and improved technology can do much to help meet people's present and future energy needs.

TEACHING STRATEGIES

The purpose of the following activities and teaching strategies is to provide you, the teacher, with a wide variety of suggestions that can be used, together with the textbook, to help develop the processes and concepts of this unit.

Pages 144-145, Unit introduction

- After reading and discussing the cartoon on page 145 you might have the students consider:
  - Tasks that they perform that require energy. They are to rank these tasks in order of the amount of energy required to complete the tasks.
  - Miming a number of tasks that require energy (e.g. mixing a cake, sharpening a pencil, mowing the lawn)
  - Preparing a list of foods they believe provide energy. Post the list. Will they think these are energy foods at the end of the unit? You might ask the school nurse to evaluate your choices of energy foods.

Chapter 1: Some kinds of energy, pages 146-163

- Whenever matter changes, the change is brought about by energy. Have the students suggest and discuss changes in matter.
  (e.g. a tree to ?; iron ore to ?; wheat to ?; sugar cane to ?; oil to ?; milk to ?) What makes these changes possible? Students might illustrate these changes.
- Page 147, Chemical energy, can be read and discussed.

Collecting Data

- Food that we eat provides chemical energy for our bodies. You can have the students research what some foods we eat provide our bodies. "Worksheet 1, Energy Foods We Eat", provides a data collection form.
- Ask the school nurse to discuss energy food with the students.
- You may wish to schedule an Energy Food Day in your class. Plan a luncheon menu with your students. Have the students contribute an energy food dish for the class luncheon. Take pictures.

Experimenting

- If possible, you could take your students outdoors to build a small fire in order to observe chemical energy released. A small fire might be started in a large juice can as suggested in "Activity Card 1, Releasing Chemical Energy".
- Students may record the results of the "Finding Out" on page 148, in the ACTIVITIES FOR EXPLORING SCIENCE book (page 28).
- Pages 148 to 151, Mechanical energy can be read and discussed. Mechanical energy is energy in motion.

Comparing

- Your students might enjoy investigating different ways their bodies use mechanical energy. In the gymnasium, the students could be asked to move their bodies from point A to point B in several different positions. Having investigated the different ways of using mechanical energy the students could rate each means of motion in terms of the energy rate consumed. Instructions might include:
  How to Move Your Body:
  1. Hands at side, roll across the floor.
  2. Move on hands and knees.
  3. Push a softball using your chin.
  4. Walk heal to toe.
  5. Crab walk.
  6. Hop on one foot.
  7. Keeping stomach on floor, move with your hands.
  8. Walk with ball between your legs.

  Students could assign a rating for "use of energy" to each of these methods of moving. How can we restore the energy we have used?

Observing — Inferring

- "Activity Card 2, Bouncing Raisins," provides an activity that will have your students considering mechanical energy from chemical energy and learning about observations and inferences.

Observing

- You might demonstrate the change of chemical energy to mechanical energy using a lawn mower or a chain saw that is powered with gasoline. A parent or another teacher may help in this regard.

Potential — Kinetic Energy

- The students might be given the opportunity to construct a device of their own creation that will demonstrate the change from potential to kinetic energy. (e.g. a tire tied to a long rope hanging from a branch in a tall tree).
- "Activity Card 3, Make a Vehicle", describes a vehicle students might construct.

— Page 152, Heat energy, can be read and discussed.

Heat Energy from Mechanical Energy

— You can have the students investigate a number of methods of generating heat energy from mechanical energy.
  1. Pull nails driven deep into a wooden block. Use a crow-bar for leverage. Feel the nails.
  2. Cut through a heavy cardboard with a long thin knife. Feel the knife.
  3. Bend a wire back and forth rapidly.
  4. Sandpaper a piece of wood vigorously.
  5. Use an electric drill to drill holes in a piece of hardwood.

— The following questions could be discussed: What are other ways to generate heat? How can we make use of the heat energy generated?

— A worksheet is provided in the ACTIVITIES FOR EXPLORING SCIENCE book (page 29) to record the results of the "Finding Out" on page 153.

— Pages 153 to 163, Radiant energy, can be read and discussed.

— Students can be given the opportunity to investigate with prisms and natural light and prisms and artificial light.

— You might have your students paint the band of colours of the visible spectrum as seen when sunlight passes through a glass prism.

Comparing

— Have the students compare the light and heat from infrared lamps with the light and heat from ordinary lamps.

— Students may record the results of the "Finding Out" on page 157 in the ACTIVITIES FOR EXPLORING SCIENCE book (page 30).

Research — Radio Waves

— Visit a local radio station, if possible. Some questions the students might try to answer:
  1. Is the station an FM (frequency modulated) station or an AM (amplitude modulated) station?
  2. Where is the station's transmitter located?
  3. What is the channel (frequency) assigned the station?
  4. How far will the radio signal transmit?

— Some of your students may be interested in making a simple radio. It is possible to purchase the parts for a crystal set in stores.

— A worksheet for the "Finding Out" on page 160, is available in the ACTIVITIES FOR EXPLORING SCIENCE book (page 31).

Experimenting

— If you have two fluorescent bulb holders available, you may wish to set up a station to compare the growth of bean plants (or other appropriate plants) using fluorescent lights which give off ultraviolet waves and lights that give off ordinary light.

— To complete the study of radiant energy students might complete "Worksheet 2, Radiant Energy".

Chapter 2: Capturing energy, pages 164-176

— Pages 165 to 169, Electrical energy, can be read and discussed.

— You may wish to have your students prepare a display of applicances that use electrical energy.

Collecting Data

— "Worksheet 3, Energy Users in the Home," can be used to record items that use electrical energy in homes.

— Students might investigate the turbine turned with water power as shown on Activity Card 4. Students could devise ways of using the mechancial energy produced by the turbine.

— Students can record the results of the "Finding Out" on page 168, in the ACTIVITIES FOR EXPLORING SCIENCE book (page 32).

— Pages 170 to 172, Nuclear energy, can be read and discussed.

— Nuclear energy can be made into electrical energy.

— Students might consider nuclear energy by studying the many new words that are used in a discussion of nuclear energy. (e.g. nucleus, atom, radioactive, uranium, nuclear reactor, radium).

— Some students might research the structure and use of nuclear reactors.

— Other students might research the nuclear submarines developed by the major powers of the world.

— Pages 173 to 176, Solar energy, can be read and discussed.

— The oldest known source of energy is the sun.

— Solar energy is being used to heat homes today.

— A discussion of this topic might raise the question about the retention of solar energy collected. Students might investigate this process by carrying out activities such as the following:

1. a. Put equal amounts of water in two plastic bags, one black and one white.
   b. Record the temperature of the water in each bag.
   c. Seal the bags and locate them in direct sunlight for 2 or 3 hours.
   d. After 2 or 3 hours measure and record the temperature in each bag.
   e. Discuss how the results of this investigation might help to plan the use of solar energy to heat homes.
2. Investigate how the heating of rocks or water might help to hold the heat in a solar heated home. This investigation is presented on "Activity Card 5, Retaining Solar Energy".

— Students may record the results of the "Finding Out" on page 175 in the ACTIVITIES FOR EXPLORING SCIENCE book (page 34).

Chapter 3: Energy in your future, pages 177-187

— People use large amounts of energy every day.

- You might have the students use their imaginations to determine new sources of energy.
  - Capture the warmth from all the smiles in the world.
  - Use fallen leaves to generate energy.
  - Roll all the old rubber tires in the world down a hill.
  - Harness the power from raindrops.

Research

- Have the students complete a file of reference materials that tell about fossil fuels.
- Have some children make a flow chart of pictures of the process of "coal to electricity".
- Some students might research the structure of an oil drilling rig and build a model using balsa wood, cardboard, toothpicks and cardboard paper rolls.
- Electrical energy can be made from chemical energy.
- Have the students collect a variety of used batteries for a display.
- You might have the students compare the "life" of a number of different brands of flashlight batteries. Which battery shines longest?
- Have students research the latest data available about the oil producers in the world today. Students might graph their data (or indicate on an outline map of the world) the amounts of oil produced each day in different parts of the world.

Communicating

Canada's energy sources (1978) were as follows:

Petroleum	46%
Nuclear	2%
Coal	9%
Natural Gas	19%
Hydroelectric	24%

- Have the student graph this information. Some students may compare this information to more recent data.
- Write for energy information to:
  Office of Energy Conservation
  Energy, Mines and Resources Canada
  580 Booth Street
  Ottawa, Ontario
  L1A 0E4
- You might make up a series of "Why" cards that students might use for study purposes, for testing fellow students or for a class quiz. The answers to the questions suggested below can be found by students as they read pages 180-187.

Why?
Nuclear reactors are built near large lakes or rivers.

Why?
Few small companies are searching for fossil fuels today.

Why?
New places must be found to get fossil fuels.

Why?
People are trying to find sources of energy other than fossil fuels.

Why?
Many people do not want nuclear power plants built near their homes.

Why?
There is a new interest in volcanoes and geysers.

Why?
Some people are using less energy than they were using.

Why?
Few towns and cities have built large solar batteries.

Why?
A pipeline has been constructed to reach the Arctic coast.

Why?
Elements used for nuclear fuel are very expensive.

Why?
Making electricity from solar energy is progressing slowly.

Why?
Few countries have nuclear reactors.

- Following a discussion of air pollution you might have the students engage in a mock trial of the executives of a company who are charged with polluting the air with the discharge from their factory.

Comparing

- Some students might be assigned to gather information comparing the advantages and disadvantages of using coal and petroleum as sources of energy. This is a good topic for a debate.

Constructing models

- Some students might set up a display of fossil fuels with accompanying information.
- "Activity Card 6, Wind Energy" lets students make models of equipment that use wind energy. Stress should be that they are "working" models to show how man uses wind energy as a means of pumping water, in sports, in transportation.
- Students could be asked to construct a solar hot dog cooker, as described in Activity Card 7. Time of year and location will be factors affecting the success of this project.

Conserving Energy

- Canadians are big energy users. Our climate, the great distance across our country and the fact that we like to live comfortably cause us to use a great deal of energy.
- You and your students might conduct an energy-saving campaign. You might prepare:
  1. Posters urging others to conserve energy.
  2. An award for all of you for your energy saving efforts.
  3. A form for students to record their energy saving efforts is outlined on Worksheet 4. Each student might campaign for a set period of time (1 week). Tabulate results on a large class summary chart.

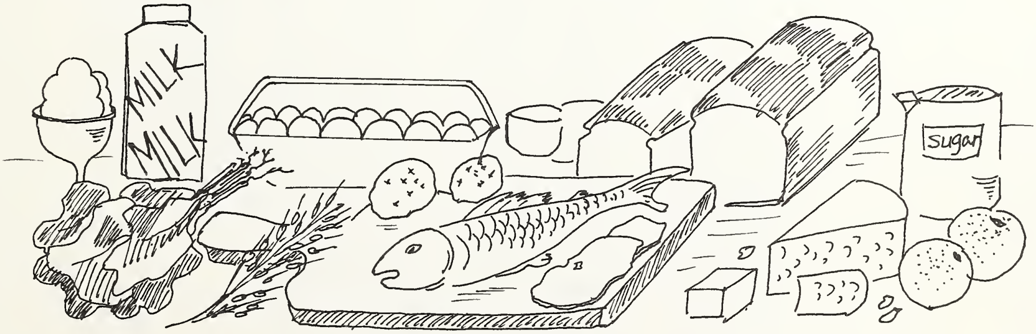
ENERGY FOODS WE EAT

Locate a reference that will tell you about the foods we eat and what these foods provide for our bodies.

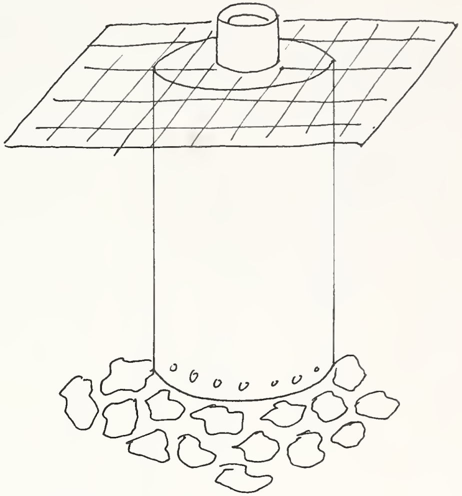
- Record your information below:

FOODS	NUTRIENTS PROVIDED	HOW OFTEN I EAT IT
cereals	carbohydrates	
bread		
cheese		
fish		
sugar		
eggs		
milk		
citrus fruit		
potatoes		
spinach		
liver		
ice cream		
raisins		

Three high energy foods we should eat are:



RELEASING CHEMICAL ENERGY



How much change in temperature can be accomplished when chemical energy is released?

You will need: a large juice tin (fire tin without lid and with holes punched along bottom)
a screen to cover top of can
a double sheet of newsprint
a small tin to hold approximately 75 mL of water
a thermometer

- Prepare a rock base to locate your large tin.
- Strip your paper as you see fit.
- Place 75 mL of water in the small tin.
- Place a portion of your newsprint in your fire tin and place your screen and small tin in place.
- Fire the newsprint in the fire tin.
- Add the remainder of your newsprint to the fire as needed to maintain a constant heat.
- When you have burned all your newsprint, check the temperature of the water in the small can.
- Has the temperature of the water changed? How much?

- Repeat this investigation.
- Can you increase the change in temperature of the water using the same amount of newsprint each time?

Changes in Energy, Activity Card 1

BOUNCING RAISINS

You will need: a heaping spoonful of baking soda on a piece of paper.
6 raisins
225 mL of water
150 mL of vinegar
paper towel or newspaper
a wide mouth glass jar (approx. 750 mL)

- Pour water into the jar.
- Put baking soda in the water and mix it.
- Watch the solution for one minute. Any observations?
- Drop in the six raisins, one at a time.
- Observe them and the solution for at least one minute. Record your observations.
- Add the vinegar gradually.
- Watch what happens. What do you observe? What inferences can you make?

Note: Inferences are conclusions we make on the basis of what we see and what we know.

OBSERVATIONS	INFERENCES

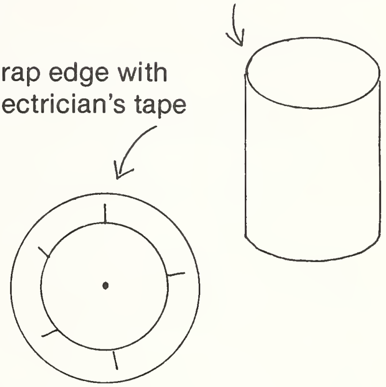
- Share your observations and inferences with someone else.

Changes in Energy, Activity Card 2

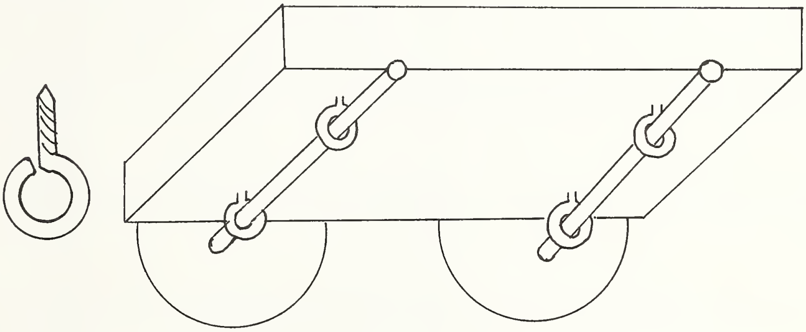
POTENTIAL-KINETIC ENERGY

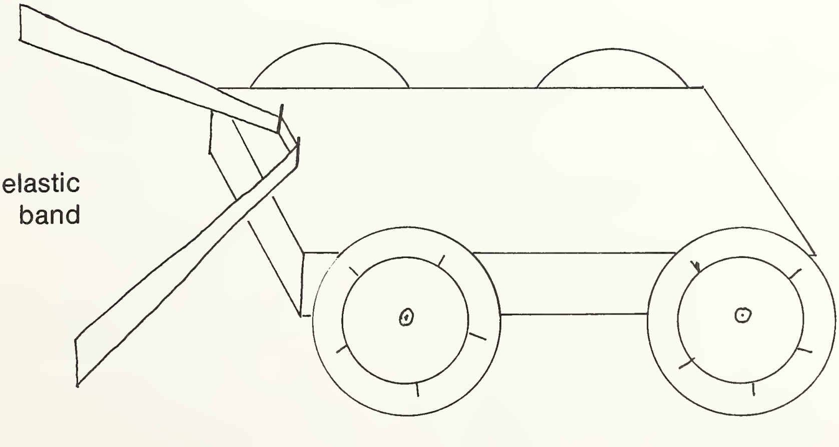
Make a Vehicle

You will need:
- a piece of wood, approx. 20 cm x 9 cm x 2 cm
- 4 screws with eyelets
- 2 pieces of dowelling, each approx. 10 cm long
- 4 wheels — e.g. top of tin can or equivalent
- electrician's tape to wrap edges of wheels
- 4 small nails or thumb tacks
- a large elastic band


lift lid on the side if possible
wrap edge with electrician's tape
tin can

Plan a way to move your vehicle!

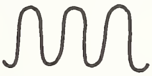




Changes in Energy, Activity Card 3

RADIANT ENERGY

Complete the missing information:

	FORM	WAVE LENGTH	HOW WE USE IT:
	radio waves		
	infra-red waves		to heat food.
red	visible light		
orange			
yellow			
green			
blue			
indigo			
violet			
	ultraviolet waves		to kill germs
	x-ray waves		
	gamma rays		

Changes in Energy, Worksheet 2

ENERGY USERS — in the home

In my home, located at ______________________________

______________________________, the following electrical appliances are used:

APPLIANCE OR TOOL	WATTAGE	APPROX. NO. OF MIN. USED EACH DAY	

DEFINITIONS: ______________________________

watt ______________________________

kilowatt ______________________________

kilowatt hour ______________________________

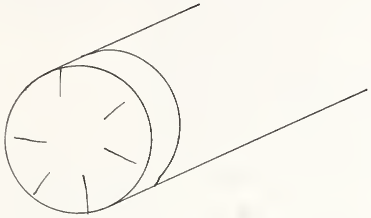
____

DATA COLLECTED BY ______________________________

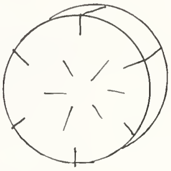
Changes in Energy, Worksheet 3

THE WATER TURBINE

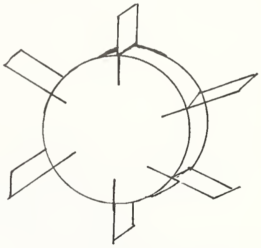
How to construct a turbine:



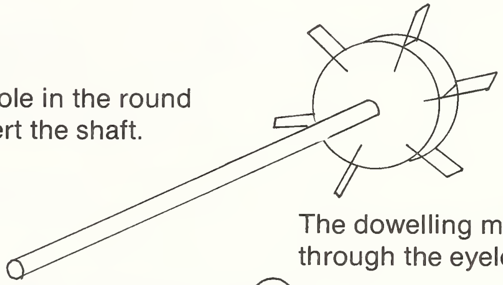
1. Cut a round from a piece of tree limb.



2. Saw slots in the round.

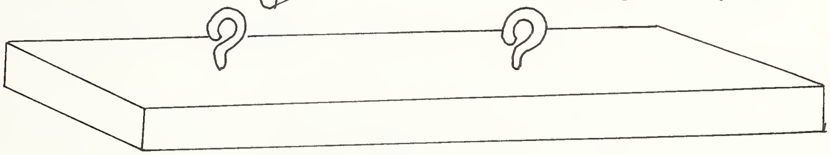


3. Insert flat vanes in the slots.

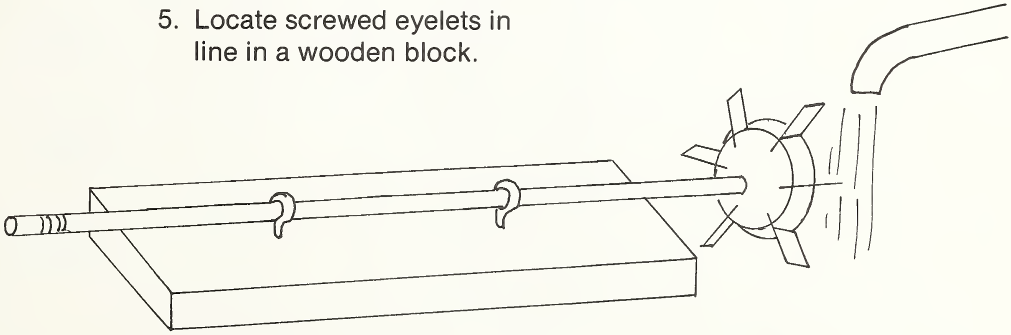


4. Drill a hole in the round and insert the shaft.

The dowelling must fit through the eyelets.



5. Locate screwed eyelets in line in a wooden block.



6. Locate turbine under a flow of water.

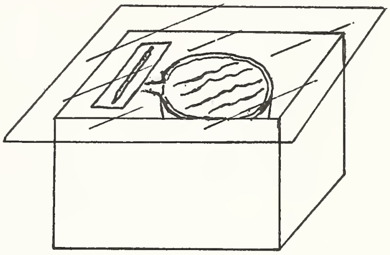
What is the source of the energy?

How can you use the mechanical energy?

RETAINING SOLAR ENERGY

How can the heat from solar energy be retained in a home?

You will need: 3 cardboard cartons or equivalent
3 thermometers
some stones (about lemon size)
a flat pan of water (to fit in the carton)
3 flat pieces of glass or old windows
aluminum pie plates or equivalent



- Cut the top of the cartons and locate outdoors in direct sunlight.
- Place the stone on the aluminum pie plate and place the plate in a box.
- Put water in the flat pan and place in another box.
- Mount a thermometer in each carton so that the temperature can be read through the glass top.
- Cover each carton with a piece of glass. Seal if necessary.
- Record the temperature in each box.
- Leave the boxes in direct sunlight for 2-3 hours.
- Record the temperature in each box.
- Shade the boxes from direct sunlight.
- Record the temperature in each box every 30 minutes.

Times:								
BOX1								
BOX2								
BOX3								

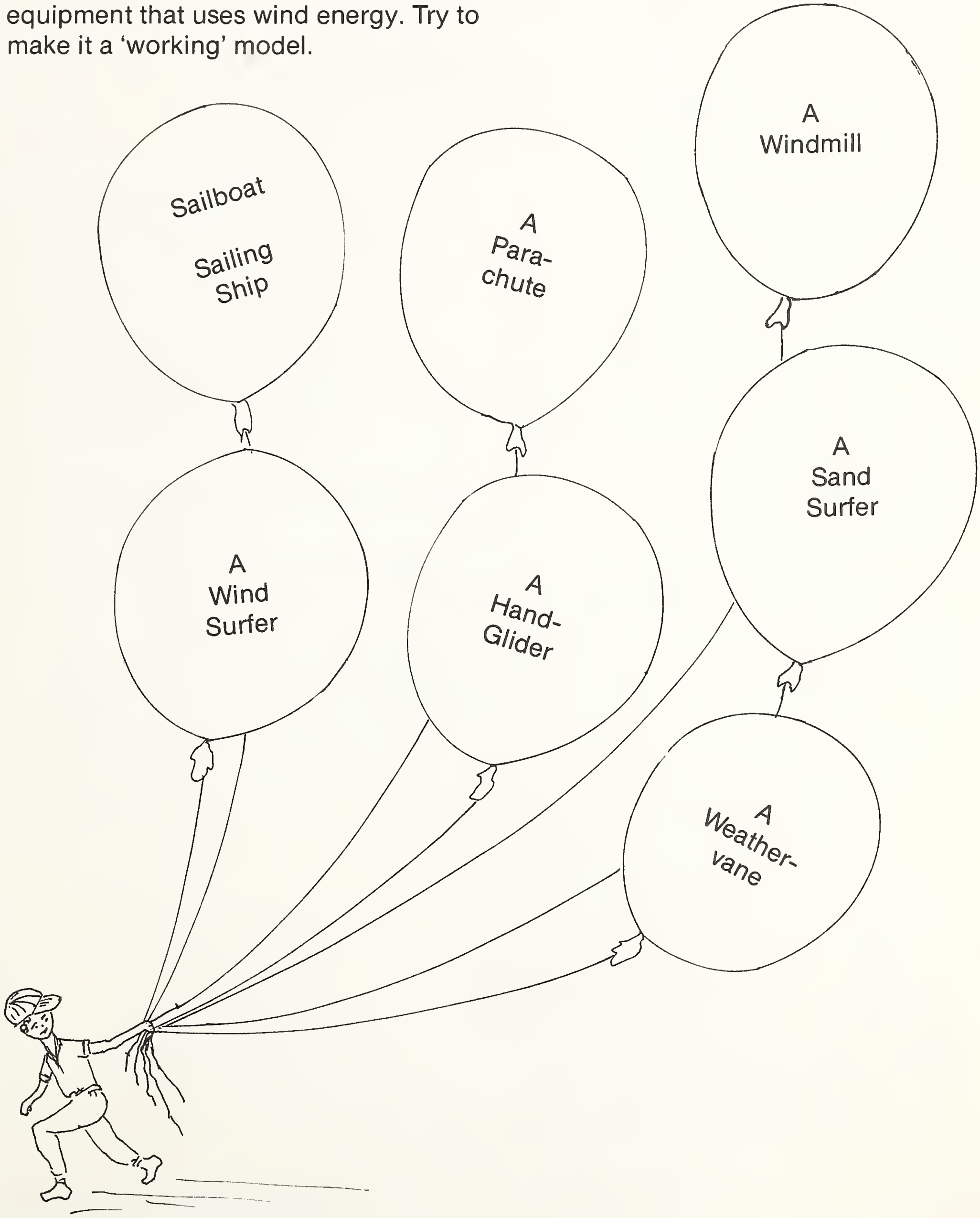
Which box retained the heat longest?

How might this information help in designing a solar energy system to heat a house?

Changes in Energy, Activity Card 5

WIND ENERGY

Make a model of one of these pieces of equipment that uses wind energy. Try to make it a 'working' model.



Changes in Energy, Activity Card 6

SOLAR

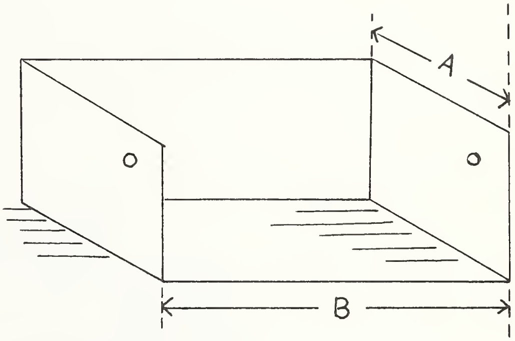
Hot Dog Cooker

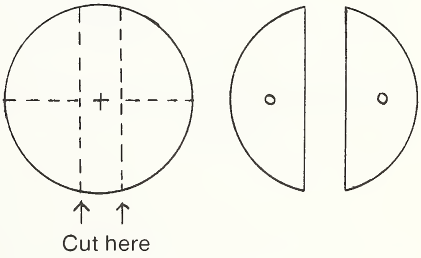
You will need:

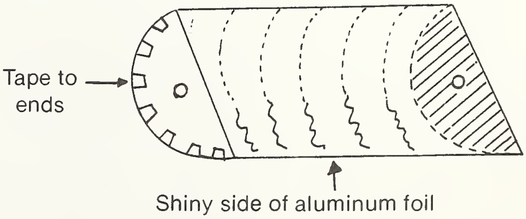
a cardboard box
corrugated cardboard
a coat hanger
a pair of pliers
4 strong elastic bands
aluminum foil
Manilla tag
all-purpose glue
tape
scissors
a hot dog!

1. Cut the top and front out of a cardboard box to make a holder for the solar cooker.
2. Draw a circle on a piece of corrugated cardboard with a radius equal to "A" in the picture.
3. Mark the centre of the circle with a dot. Divide the area between the left side of the circle and the dot into 4 equal sections. Do the same with the section from the dot to the right side of circle.

   Draw a line through the first dots you have marked to the left and right of the centre. Cut along these lines.
4. Make a small hole in the centre of each half just big enough to slip the coat hanger wire through.
5. Cut a piece of manilla tag slightly shorter than distance "B". See the first drawing. This forms the curved back of your hot dog cooker. Glue your aluminum foil to one side with the shiny side OUT.
6. Tape the foil-covered back to the two curved ends made in Step 3.



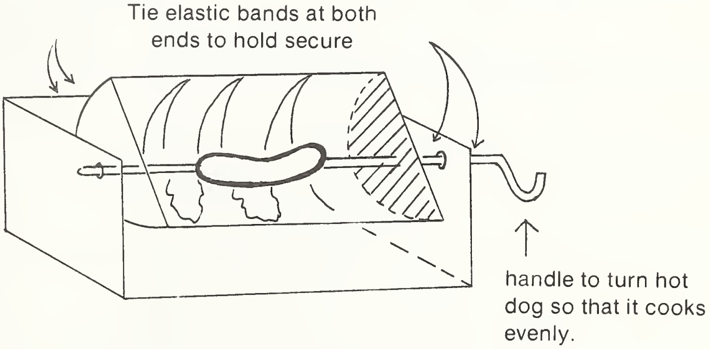




....continued

Solar Hot Dog Cooker

7. With pliers, cut and straighten the coat hanger. Bend one end to make a handle which you can turn easily. (See picture below.)
8. Push the straightened coat hanger through the one end of the box and curved reflector, the hot dog, the other end of the curved reflector and the box. (See picture below.)
   Use the elastic bands to keep the reflector and the coat hanger from slipping when you turn the handle. (The elastic bands will have to be cut, in order to wrap them around the hanger, and then tied.)
9. Angle your cooker toward the sun. Make sure you find the best position so that the sun's heat energy is reflected on the hot dog. You may have to experiment a little to find the right angle.
10. When your hot dog is cooked—you can eat it!


Tie elastic bands at both ends to hold secure
handle to turn hot dog so that it cooks evenly.

ENERGY SAVER'S GUIDE

I, ____________, have practised energy

conservation as shown below:

Check each save you make (✓).

									TOTAL
Turned off unnecessary light									
Walked instead of driving									
Turned down home thermostat									
Used less water in shower									
Cleaned the furnace filter									
Turned off "instant-on" television									
Took items to recycling depot									
Cleaned vacuum cleaner									

Total number of "saves": ________

Dates: ____________________ to ____________________

Changes in Energy, Worksheet 4

RED BOOK (6)

Unit 5: The Earth in Space

Pages 192-239

UNIT OVERVIEW

Concept Development

In the preceding levels of the program, students were introduced to the concepts of distance, direction and position in space and time. They also were introduced: to the moon, its nature and its relationship to the earth; to stars and some of their properties; and to the sun.

With each new conquest in space exploration, the universe becomes more and more part of the child's world. They are exposed to many ideas about space and space exploration through television, films, books, cartoons, games and newspapers. These forms of media propel the child into space in thought, imagination and feeling. The interest is further highlighted by the increasing impact (both good and bad) that space science is having on how people live and communicate with each other.

Concepts about space are best understood when they are related to *activities*, *models*, *analogies* and *frames of reference* that are within the students' experience. It would also be useful to review with your students the ways in which scientists collect information about space. They learn about objects, events and systems in space by observing and collecting data about changes in position, colour, temperature and phase. As our data-collecting techniques become more refined, so our understanding of space changes.

Unit 5, "The Earth in Space", deals principally with the solar system to which the earth belongs. Chapter one provides useful information about the movement and size of the planets and their moons. The second chapter investigates some interesting objects in space — asteroids, comets and meteors. Chapter three discusses certain general and some special characteristics of the sun. It also considers the effect the sun has on the earth. Chapter four focuses on space exploration and telescopes.

Process Development

Students begin the unit by *making models* of the planets to *compare* their sizes (page 198) and their distances from the sun (page 200). They then set up an *experimental model* to *demonstrate* how the sun's gravity affects the orbiting speed of a planet (page 202).

In the "Finding Out" on page 211, students *demonstrate* that smooth surfaces reflect more light than rough surfaces. From this demonstration they *infer* that the smoothness of an asteroid's surface determines how much light it reflects, rather than the size of the asteroid.

A *demonstration model* of lunar and solar eclipses is set up in the "Finding Out" on page 222. The unit ends by students *simulating* how satellites relay signals back to earth (page 233).

Related Units

Time *Orange Book (1)*
Spaces and Places *Orange Book (1)*
The Moon *Gold Book (2)*
Location, Motion and Force *Blue Book (3)*
Watching the Sky *Brown Book (4)*
Universe: Exploring Environments in Space *Exploring Earth and Space (7)*

Materials and Advance Planning

The following list includes the materials that a student, or in some cases a group of students, will need to carry out the activities in this unit. In some instances, other materials may be substituted for those on the list.

Paper; pencil; scissors; ruler; shelf paper; small rubber ball; string; modeling clay; flashlight; globe; model of the moon or small ball; darkened room; small mirror; small flashlight.

The additional activities suggested in the resource guide require: drawing board; 2 finishing nails; string; 4 balls of styrofoam; 4 straws; 4 finishing nails; a strong piece of cardboard (50 cm square); bicycle; plasticine; tin can; thermometer; 2 flat-sided rocks that fit into the can.

BACKGROUND INFORMATION

Chapter 1: Looking out from the earth, pages 194-207

The observation of the sun's apparent motion in the sky can easily lead one to conclude that the sun travels around the earth, rather than the converse. Everyday references to a "rising" and "setting" sun tend to reinforce this erroneous idea. It is no wonder that peoples of ancient civilizations based their astronomical studies on this misconception.

When people move at a uniform speed, they are not necessarily aware of their motion. Only a sudden acceleration or deceleration makes them aware that they are moving. Your pupils may have experienced the phenomenon of being in a car, train or boat when an adjacent vehicle appeared to move forward or backward. Later they may have discovered that it was the vehicle in which they were traveling that moved, not the adjacent one. Such an example brings into focus the problem of deciding which object is moving in relation to the other, the earth or the sun. Copernicus was aware of this problem and argued that the apparent motion of the sun around the earth could just as easily be explained by the motion of the earth around the sun. Such reasoning led to the formulation of Copernicus's model of the solar system.

In Copernicus's model of the solar system, the earth and the other planets traveled in definite orbits around the sun. This new concept of the cosmos threw open the search for further information about the motion of objects. Galileo studied the way objects become accelerated as they fall freely. Isaac Newton discovered the force that keeps the earth and other planets in orbit around the sun. As a result, Newton formulated the law of universal gravitation. Karl Friedrich Gauss invented a method of determining the orbit of an object moving around the sun by making observations of the object that extended over only a few weeks.

The text provides the pupils with some of the information presently known about the solar system, comparing the various planets as to size, moons, period of revolution and period of rotation. It must be kept in mind, though, that as people continue to study and explore the solar system, much of the information presently known is subject to change.

Your pupils may be aware that our solar system is probably not the only solar system in the universe. Every star is a potential sun, which may have various planets orbiting it. Scientists have detected evidence of eight or more solar systems in our galaxy. They have not seen any planets orbiting the suspected suns as yet. But from the way these stars behave, each of them may have one or more companions about the size of Jupiter orbiting it. The nearest of these stars in question, Barnard's Star, is about 6.1 light-years from the earth.

Chapter 2: Some interesting neighbours, pages 208-217

The study of asteroids, or minor planets, has provided scientists with much valuable information about the solar system. Asteroids serve as important records of conditions in the early stages of the solar system. This is because they are made up of samples of the original material from which the solar system is thought to have been formed. Asteroids have not undergone the changes that have affected the matter that exists on the earth.

The asteroids all revolve about the sun in the same direction as the planets, that is, from west to east. Besides Hermes, which is mentioned in the text, two other asteroids have passed within 5 million kilometres of the earth. They are Apollo, which was seen in 1932, and Adonis, which was seen in 1936. Apollo was again sighted in close proximity to the earth in 1973.

The discovery of an asteroid is usually accidental. For example, some have been discovered when they left their trails on photographs taken for other purposes.

Also appearing in our solar system from time to time are large, unstable bodies called comets. They are apparently composed of partly frozen gases, dust, ice and small rocks. A few are temporarily visible when they sweep near the sun and then move far out again in immense, elongated orbits. Comets have so little mass that the pressure of solar radiation and the force of the solar wind cause a long streamer to flow from the comet head. The streamer, or "tail," typically flows away from the sun, no matter in what direction the head travels.

A typical comet that is bright enough to be seen by the unaided eye has the appearance of a spot of light, somewhat smaller than the full moon and much less brilliant. Like the moon and the planets, comets shift their position in the sky from night to night.

Meteors, or "shooting stars," are fragments of rocks and metal that seem to come from pieces broken off from asteroids and comets. Most meteors are no larger than a grain of sand, but some are huge and weigh tons. Meteors are believed to have originated in our solar system. To discover the origin of a meteor, astronomers study its orbit, which can be determined by noting its speed and direction.

The majority of meteors have speeds between 12 and 72 km/s. Faster meteors are brighter and more likely to leave a trail than slower meteors because the faster meteors have greater energy on entering the earth's atmosphere. However, the faster meteors often burn up before reaching the earth.

Most meteorites discovered on the earth's surface are small, but a gigantic meteorite that struck the earth 50 000 years ago is believed to be responsible for the huge, well-known crater located near Winslow, Arizona.

Chapter 3: A special neighbour, pages 218-226

People have wondered for a long time where the sun gets its tremendous energy. The sun is composed of an enormous mass of intensely hot gases. The sun's mass exerts a tremendous gravitational pressure on the matter deep inside it. This causes hydrogen atoms to fuse, forming helium atoms. When this happens, some of the matter in the hydrogen atoms is changed into energy. Thus nuclear fision produces the great amounts of energy that the sun releases.

Most of the energy generated by the sun goes into space. A fraction of this energy is received by the earth in the form of radiant energy. Some of this energy is in the form of visible light rays. Some other forms of radiant energy released by the sun are invisible ultraviolet rays, X rays, and infrared rays. It is estimated that the sun's hydrogen-fusion process will continue for about five billion more years.

The only parts of the sun that can be observed directly are its outer layers, which are known as the sun's atmosphere. The three general layers of the atmosphere are the photosphere, the chromosphere, and the corona. The photosphere is what we see when we look at the sun. The layer above the photosphere is the chromosphere. It can be observed for only a few seconds during a total solar eclipse. The bright red colour of the chromosphere cannot usually be seen because of the bright light of the photosphere, which overshadows it. Photographs of the sun made during a solar eclipse have made it possible to study the chromosphere. It has also been studied with an instrument known as a coronagraph that blocks out the light from the surface of the sun. The element helium wad discovered in the sun's chromosphere before it was found on the earth.

The outermost layer of the sun's atmosphere is a shimmering, filmy halo called the corona. It reaches far out into space, becoming progressively thinner as it spreads out. Actually, the corona reaches out beyond the earth. The corona also can be studied only during solar eclipses or by using a coronagraph.

The sun's surface is frequently disturbed, possibly by huge magnetic storms inside the sun. Several kinds of activity may be observed at these times: solar flares, solar prominences, and sunspots.

Chapter 4: A closer look at the universe, pages 227-235

Ancient skywatchers discovered much interesting and useful information about objects in the sky. But it was not until telescopes were invented that astronomers became aware of the billions of stars that populate the sky.

On the whole, two main kinds of optical telescopes — the refractor and the reflector — are used to study objects in the sky. A third kind of telescope, the Schmidt telescope, is a compromise between the reflector and the refractor telescopes. The Schmidt telescope differs from a reflecting telescope in that the Schmidt telescope has an extra lens at the center of curvature of the mirror. Both the mirror and the lens are used to form an image of the object.

Each of the telescopes mentioned here has its own special advantages. An astronomer's choice of telescope depends on the type of project to be worked on. Refractor telescopes are best for the measurement of accurate positions and small angles in the sky. Reflector telescopes are best suited for photographing faint surfaces in shorter times than refractors can. The Schmidt telescope can be made to produce excellent images over a large field. The 124 cm Schmidt telescope on Mount Palomar in California can record a large area of the sky on a single photograph that would require four hundred photographs if recorded by the largest reflector telescope.

Refractor telescopes have one serious disadvantage. The objective lens can be supported only at the rim, and only a relatively small lens can be properly supported. A larger lens would bend under its own weight. The largest refractor telescope has an objective lens of 102 cm. It is located at the Yerkes Observatory at Williams Bay, Wisconsin. The telescope belongs to the University of Chicago.

Reflector telescopes can have much larger objective surfaces. Since the objective is a mirror, it can be supported from the back without interfering with the image. The largest objective mirror is 5.08 m wide. It is located at the Hale Observatories on Mount Palomar in California.

Much new information is being gathered about our solar system as a result of the various space probes. In 1959, *Luna 1* (U.S.S.R.) was the first space probe to orbit the sun. Since then, space probes have studied or are on their way to study the entire solar system. The *Mariner* (U.S.) probe photographed Mercury and Mars. The *Venera* (U.S.S.R.) and the *Mariner* (U.S.) probes photographed Venus. *Pioneer 10* (U.S.) photographed Jupiter. The *Voyager* (U.S.) probes photograph Jupiter, Saturn, Uranus, and Neptune. Some of the *Venera* (U.S.S.R.) probes landed on Venus and two *Viking* (U.S.) spacecraft landed on Mars.

These space probes have changed many of our ideas about the planets that they observed. Mercury was found to be somewhat like the earth on the inside but more like the moon on the outside. Venus had once been regarded as the earth's twin. It was thought to have surface conditions similar to the earth's. Although much remains to be found out about Venus, it is now known that it is not like the earth at all. Its surface is very hot at 482° C. The greenhouse effect causes the atmosphere of Venus to retain most of the heat it receives from the sun. The scientific laboratories carried to Mars aboard the *Viking 1* and the *Viking 2* space probes have relayed to the earth much valuable information about our neighbouring planet.

TEACHING STRATEGIES

The purpose of the following activities and teaching strategies is to provide you, the teacher, with a wide variety of suggestions that can be used, together with the textbook, to help develop the processes and concepts of this unit.

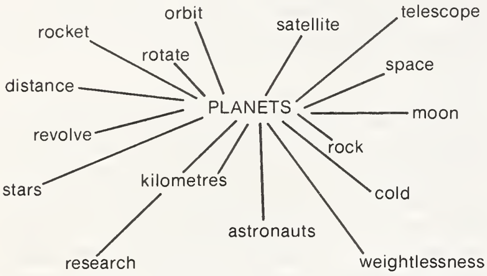
- —Pages 192-193, Unit introduction, can be read and discussed.
- —Consider the cartoon and the questions on page 193.
- —How many planets can each student name from memory? You might discuss a method of remembering the names of planets. e.g. the students could

structure a catchy wording that will help them remember.

Mercury	Venus	Earth	Mars
My	*Very*	*Eager*	*Monkey*

Jupiter	Saturn	Uranus	Neptune	Pluto
Just	*Stole*	*Uncle*	*Ned's*	*Pipe.*

— A word bank might be developed as an introduction. e.g. Have the students help you create a "semantic map" of words related to the key word planets.



Chapter 1: Looking out from the earth, pages 194-207

In approximately 150 A.D. the Greek astronomer Claudius Ptolemy wrote that the Earth was a sphere, was motionless, and centred the universe of his day. Mercury, Venus, Mars, Jupiter, Saturn, the Moon, and the Sun circled the Earth in a looping fashion.

— You might have the students prepare diagrams of their interpretation of this information.

OR

— Groups of students carrying models of the heavenly bodies might demonstrate the motion and position of the planets, moon, and sun in Ptolemy's Earth-centred universe.

During the sixteenth century the Danish astronomer Tycho Brahe furthered the work of Nicholas Copernicus. Brahe spent many years observing and mapping the changing positions of the planets. His accurate observations and measurements had him questioning the Copernican model and the shape of the orbits.

Johannes Kepler, born in 1571, used a knowledge of mathematics to continue the Copernican idea of the Sun as the centre of the universe and to determine the elliptical orbit of the planets.

Each of these men spent a good part of their lives attempting to justify their theories of the structure of the universe.

— Students might be asked to:
  — Dramatize the thinking and the working of Ptolemy, Copernicus, Brahe and Kepler in a short play that would have each actor using diagrams and a good understanding of the contributions that each scientist made to our knowledge of the universe.

— Pages 195 to 203, The planets, can be read and discussed.

The Planets — Observing

— Information concerning when certain planets and constellations can be viewed in the sky is available in the SKY CALENDAR found in the publication SCIENCE AND CHILDREN issued eight times a year. Another source of this information is:

National Museum of Canada, Science & Technology
1867 St. Laurent Blvd., Ottawa, K1A 0M8

— Students usually become enthusiastic observers if they are successful in locating some specific sky body at the outset. (See the resource unit for Watching The Sky, Grade 4).

Size of Planets — Using A Scale

— The assignment suggested below may be used as an alternative to the "Finding Out", page 198.

The scale 1 cm: 10 000 km can be used to compare the size of the planets and later this same scale can be used to investigate the distances of the planets from the sun.

— "Activity Card 1, Scale Models of the Planets" has the students using the above scale to establish diameters for the planets that can be used to make scale models of the planets and the sun.

NOTE — Although each student or pair of students might each construct models of the planets, it is usually best if a small group of students construct one scale model of the sun for the class to use.

— If your students do the "Finding Out" on page 198, a worksheet is available in the ACTIVITIES FOR EXPLORING SCIENCE book (page 35)

Moving In Space — Recording Information (page 199)

— Some students may construct a graph to compare the revolution time of the planets.

— Students could discuss:

For You To Think About

> The farther the planet is from the sun the longer its period of revolution. Does this mean that the outer planets move much slower than the inner planets?

— On the playground the students might investigate the speed of the revolving planets in a fun activity in a large open area.

Nine students will grasp a very long rope at different spots along the rope. One student (The Sun) will anchor the rope at one end.

The students will start moving in orbit about the stationary sun trying to keep the rope straight at all times.

When the pace of the students is speeded up, what happens?

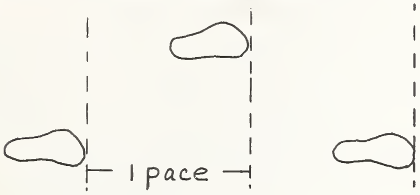
Planet Distances From the Sun

— "Activity Card 2, Distance: Planets — Sun" describes a procedure for using the same scale used to compare the planets to compare the distances between the planets and the sun.

- When students use their scale models of the planets to consider the distance between the planets, the concept of distance in space should become more meaningful.
- Students may record the results of the "Finding Out" on page 200, in the ACTIVITIES FOR EXPLORING SCIENCE book (page 36).

Measuring By Pacing

- Students might be taught to use the length of their pace as a measuring tool at this point.



- Mark off a measured distance on the playground. (10 m, 20 m, or 30 m...)
- Have the student walk the measured distance counting the number of their normal paces it takes to cover the distance.
- Students are to walk the distance several times and average the number of paces for each trial.
- Have the students divide the measured distance (in centimetres) by the average number of paces it took to walk the measured distance.

  e.g. 30 m = 3 000 cm

  $$\frac{3\,000 \text{ cm}}{54 \text{ paces}} = 55.5 \text{ cm}$$

  the length of my pace is 55.5 cm.
- Have students measure several distances about the school using the length of their pace to determine an approximate measure.
- After the students have measured several distances using their pace measure check the accuracy of the measures using a metric tape measure.

- Students may record the results of the "Finding Out" on page 202, in the ACTIVITIES FOR EXPLORING SCIENCE book (page 37)

Revolution and Rotation of Planets

- You might have the students investigate the concepts of revolution and rotation as described in "Activity Card 3, Revolution and Rotation".
- See the resource unit for the Grade 4 unit Watching the Sky for additional activities concerning seasons, rotation and revolution.

The Earth's Gravity

Gravity — is the force of attraction that acts between all objects because of their mass.
— is the force that holds the moon in orbit about the earth and the planets in orbit about the sun.

- Students might investigate how the force of the earth's gravity holds things to the surface of the earth in spite of the speed of the rotating earth. "Activity Card 4, Gravity — A Pulling Force" provides an investigation students might *observe*. Then they can *consider a hypothesis* about the force of gravity and the revolving planets staying in orbit.
- Some students might research the findings of the English scientist, Isaac Newton, and explain his theory of gravitation to the class.
- Students can discuss: For You To Think About

> The weight of an object is the measure of the gravitational pull of the earth on this object. What would be the weight of an object at the centre of the earth?

Moons (page 204)

Just as the earth's gravity pulls on the moon, the moon's gravity pulls on the earth and the waters in the large bodies of water directly under the moon. "Activity Card 5, Moon — Earth", has the students comparing the earth and the moon, making inferences about the gravitational pull of one body on the other, and locating information about tides on the earth.

If tidal waters are close by, the students might investigate:

- the schedule for high and low tides.
- what problems or benefits result from the changing water line.
- the position of the moon during local high and low tides.

Other Planets' Moons (page 206)

The Voyager 1 and the Voyager 2 spacecrafts launched in 1977 have provided much information about Jupiter and Saturn. See: National Geographic, January 1980 and July 1981.

- Students might be asked to locate these references and determine what new information has been found about the moons of Jupiter and Saturn.
- Through the years people on earth have gazed upon the moon for many reasons. If at all possible the students should be given the opportunity to view the moon through a telescope. If the local school district does not have a telescope for you to borrow, perhaps a parent or a local resident may be able to help provide this experience for your students.
- Students might search out poems that have been written about the moon or write poems of their own thoughts as they view the moon. An attractive display might be structured using poems that can be copied or written.

Chapter 2: Some interesting neighbours, pages 208-217

- The study of asteroids, comets and meteors might have the students developing their research skills.

1. Have the students search out information about asteroids, meteors and comets.

- Each student might be required to complete one card for a class file.
- Encyclopedias might not be listed.
- Reference cards might be prepared for asteroids, meteors, gravity, planets, telescopes, etc.

e.g.

References ______		Topic ______		
Title	Author	Publisher	Date	Location
Information provided by ______				

2. After students have considered the information on pages 208-217 they might be asked to prepare two or three questions that they would like answered.

e.g.

What I Would Like To Know About Asteroids:
Questions:
1. ______
2. ______
3. ______
4. ______

Prepared by ______

3. The students in your room might be grouped in teams that are given the names, ASTEROIDS, COMETS and METEORS. These groups might be involved in many projects and competitions during the study.
4. Your students might complete Worksheet 1 to compare the features of asteroids, comets and meteors.

- Students may record the results of the "Finding Out" on page 211 in the ACTIVITIES FOR EXPLORING SCIENCE book (page 38).
- An alternative for the "Finding Out" on page 211 would have the students investigating the reflected light from a smooth surface of aluminum foil or the surface of foil that has been crumpled. Darken the room and compare the reflected light from each surface.

Chapter 3: A Special Neighbour, pages 218-226

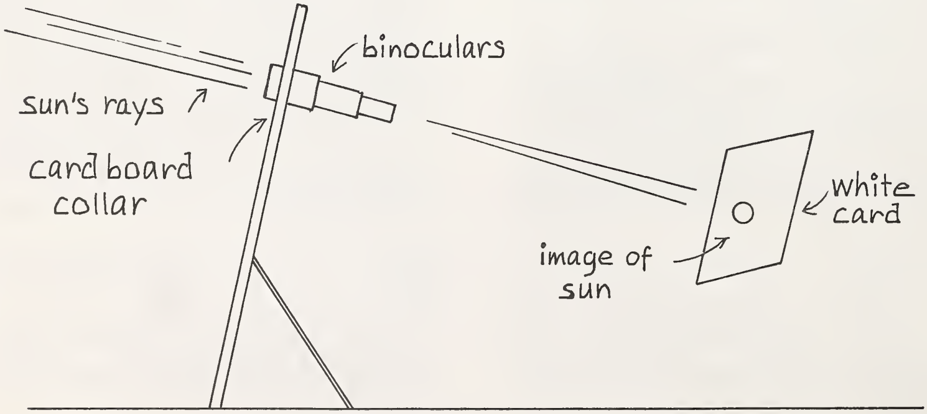
Some Questions About the Sun, (page 219)

- Your students will learn much about the sun by conducting a survey which will tell them what people in their community know about the sun. They might survey their parents, their relatives, their friends or the person in the street to collect their data.
- The method of conducting the survey should be discussed at length with your students.
- A suggestion for a survey form is given on Worksheet 2.

How the Sun Affects the Earth (page 220)

- A good discussion of For You To Think About, page 220, will make the students aware of the dangers of the sun.
- A worksheet for the "Finding Out" on page 222 is available in the ACTIVITIES FOR EXPLORING SCIENCE book (page 39).
- Students might be given the opportunity to study the surface of the sun as follows:

  Hold or mount a pair of binoculars in order that an image of the sun will fall on the piece of white cardboard as shown. Vary the distance between the binoculars and the white cardboard as shown. Vary the distance between the binoculars and the white cardboard until the largest clearest image of the sun is obtained.



Students might view the image over several days and observe any changes in the location of sunspots or other surface features of the sun. This is an excellent way to view the sun setting on the horizon.

Something Extra

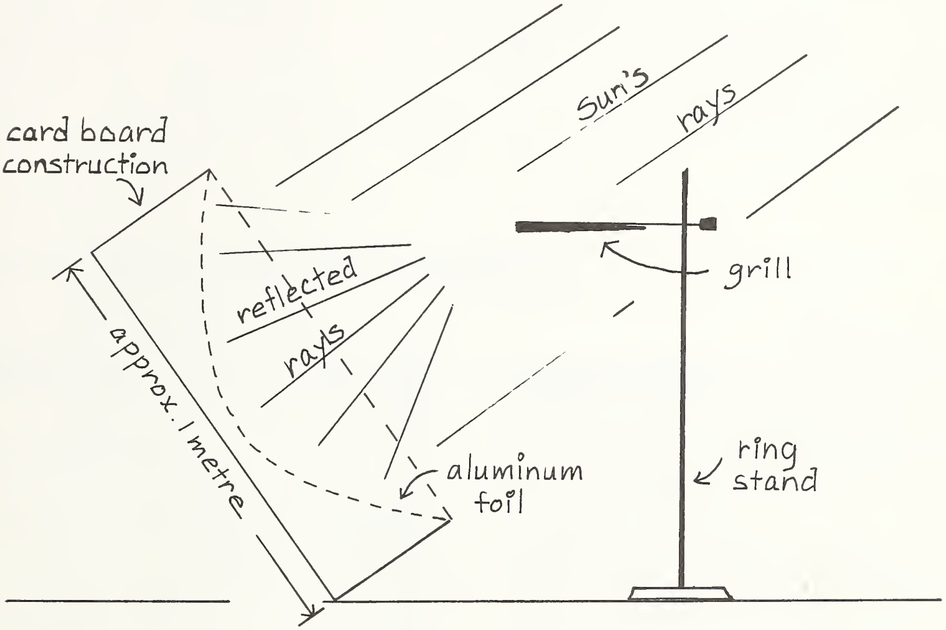
You may have a student in your class who could research and construct a solar cooker using cardboard, aluminum foil and some form of ring stand if available.

— The reflector cooker is set up to reflect the rays of the sun to a focal point where the grill might be located.

— When you consider the Exploring on Your Own, page 226, you might present the verse,

A red sky in the morning
Is a sailor's warning
A red sky at night
Is a sailor's delight

— Students could discuss: How might this verse have originated? Is there any truth to this thought?



Chapter 4: A closer look at the universe, pages 227-235

Telescopes

— Try to find someone in the community who has a telescope that they would explain to the students, and permit the students to view some distant objects.

— It might be necessary to organize a sky watching session one evening that is convenient to the owner.

— Check the SKY CALENDAR for the best time of year to view stars and planets.

Constructing a Telescope

Instruction for the construction of a telescope can be found in many references. e.g. ASTRONOMY — EXAMINING YOUR ENVIRONMENT, Holt, Rinehart and Winston; THE WORLD BOOK ENCYCLOPEDIA (see: Telescope).

You might wish to have your students purchase telescope kits or perhaps your school might purchase a number for your science classes.

Your students might construct cut-away models of the refractor and reflector telescopes for display using cardboard tubes and lens and mirrors shaped out of wax, soap or wood.

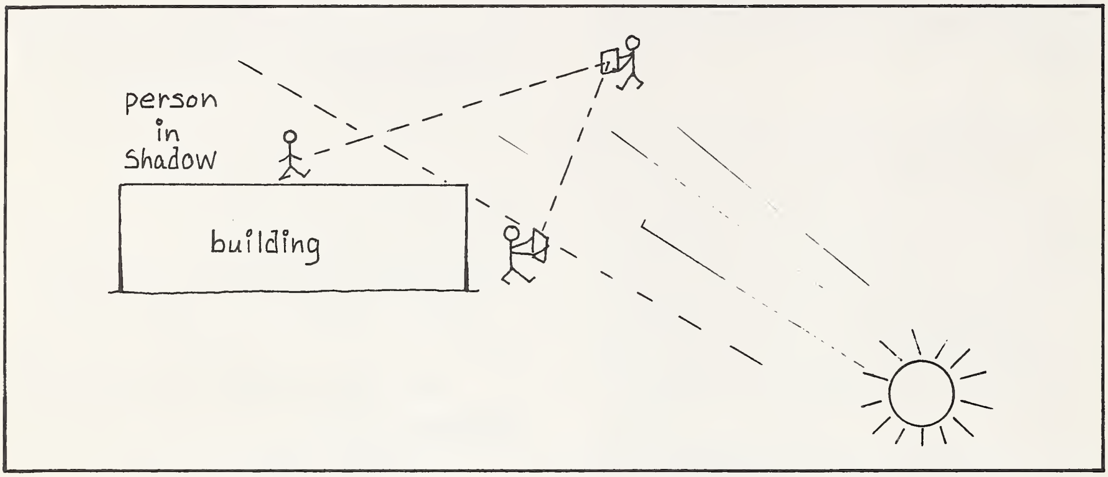
Space Exploration and Travel, (page 231).

A time line of manned space flights might be constructed by the students. A list of flights can be found in THE WORLD BOOK ENCYCLOPEDIA (See Space Travel).

Communications Satellites

— Students may record the results of the "Finding Out" on page 233, in the ACTIVITIES FOR EXPLORING SCIENCE book (page 40).

- The students might investigate further the relaying of satellite signals as provided in the "Finding Out", page 233, by relaying light from the sun around the corner of a building using mirrors.
- Some students might be given the task of researching some of the many communications satellites that have been launched. "Worksheet 3, Communication Satellites" might be used to record the data.



Moon Visitors (page 234)

- Powerful rockets have been developed to carry spacecrafts and astronauts beyond the initial grasp of the earth's gravitational pull. The Saturn V rocket that propelled the spacecrafts that eventually put men on the moon might be investigated by your students.
- You might have your students construct cardboard models of the three stage Saturn V launch vehicle as shown on Activity Card 6. Models may vary in size. You could simulate the flight and the lunar landing of the Apollo 11 in July of 1969 with the students.
- Starting at 9:32 a.m. one morning you might have your class launch their Saturn V models. Three minutes later the students are instructed to separate the used first stage of their rockets. The students can follow step by step through the eight day journey to the moon's surface and back to the splashdown on earth.
- "Activity Card 6, Apollo II—Lunar Landing" provides some of the highlights of the flight that the students might attempt to demonstrate.
- Students can also research and prepare a report on the space shuttle program.
- Your students might consider an activity that will have them thinking about the purpose of space flights and what we can learn from such flights. The students might work in teams to complete the tasks outlined in "Worksheet 4, Space Flight Plan". Some time might have to be given to assisting the students with the structuring of the questions.

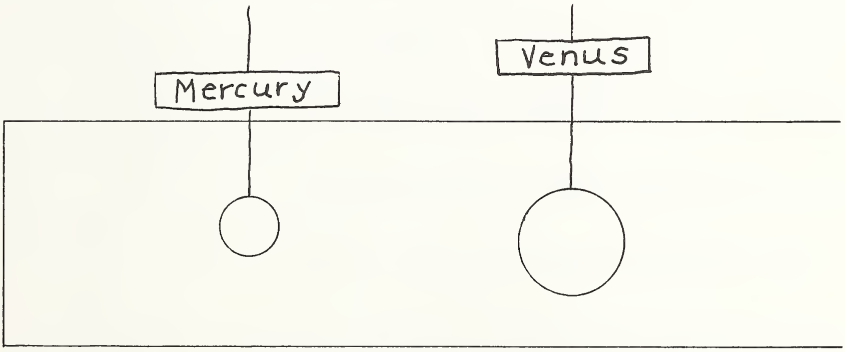
SCALE MODELS OF THE PLANETS

STEP 1:

PLANETS	DIAMETERS (km)	SCALE DIAMETERS	CALCULATIONS:
Mercury	4 848	.48 cm	$\frac{4\ 848}{10\ 000}$ X 1 cm = .48 cm
Venus	12 080	1.2 cm	
Earth	12 683		
Mars	6 760		
Jupiter	142 000		
Saturn	120 900		
Uranus	46 700		
Neptune	49 500		
Pluto	6 400		
Sun	1 384 000		

Step 2: Construct accurate models of the planets using the scale diameter. Display the scale models in some way.

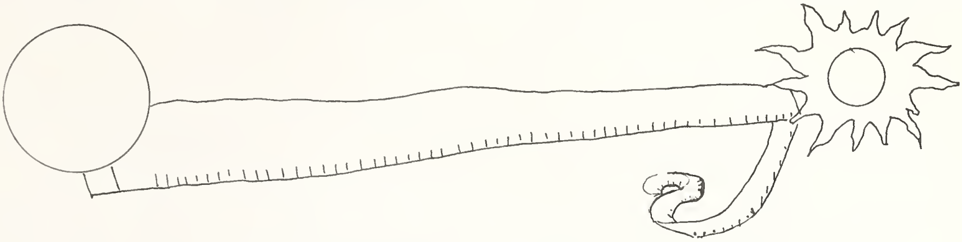
Step 3: Compare the size of your scale model planets with the scale model of the sun.



QUESTIONS TO CONSIDER:

How many planets the size of Mercury would fit inside the sun?

How can we compare the scale models of the planets with the scale model of the sun at the appropriate distance?



DISTANCE: PLANETS ⟷ SUN

Step 1: Complete the chart below using the scale. (1 cm: 100 000 km)

PLANETS	DISTANCE FROM SUN	SCALE DISTANCE	CALCULATIONS:
Mercury	57 900 000 km	5.8 m	$\frac{57\,900\,000}{100\,000} \times 1 \text{ cm} \div 100$ $= 5.8 \text{ m}$
Venus	108 230 000 km	10.8 m	
Earth	149 590 000 km		
Mars	227 720 000 km		
Jupiter	778 120 000 km		
Saturn	1 428 300 000 km		
Uranus	2 872 700 000 km		
Neptune	4 498 100 000 km		
Pluto	5 914 300 000 km		

Step 2: Take the scale models of the planets and the scale model of the sun to the playground or a large open area.

Step 3: Locate the scale model of the sun at the edge of the area. (Diameter of scale model: approximately 138 cm).

Step 4: Measure 5.8 m from the location of the model of the sun to position the scale of Mercury. Use a metric tape measure or your pace measure to determine the distance.

Step 5: Measure 108.2 m from the location of the model of the sun to position the scale model of Venus.

Step 6: Position as many other scale models of the planets as is possible.

Step 7: *Consider:*

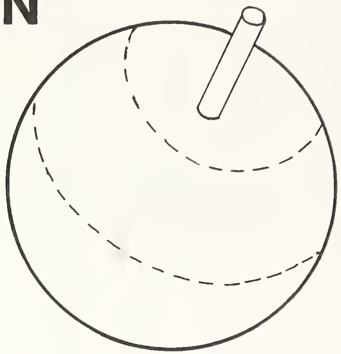
1. How might we describe the distance between the planets and the sun. (Remember we are working with scale distances).

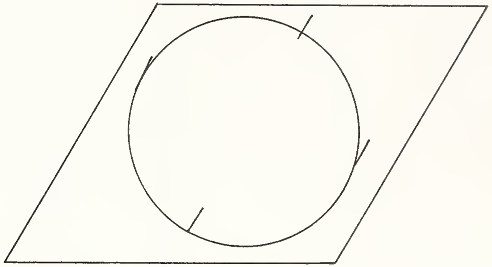
2. If we could move our scale model planets in orbit at different speeds how would the distances between the planets change?

The Earth in Space, Activity Card 2

REVOLUTION AND ROTATION

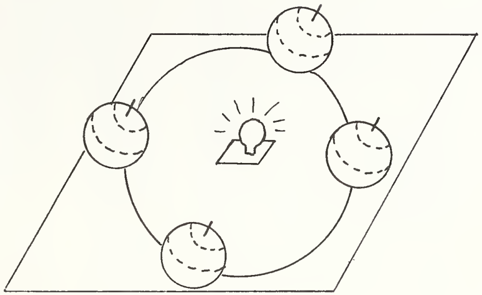
A Model To Construct





You will need: 4 balls of styrofoam, plasticine, clay or equivalent
4 straws
4 finishing nails (approximately 6 cm long)
a piece of wood or reinforced cardboard (approximately 50 cm by 50 cm)

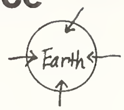
- Push a large nail through the balls of styrofoam.
- Remove the nail and insert the straw.
- Drive the finishing nails into the piece of wood or cardboard at four points on an orbit drawn on the wood. Angle the nails slightly (23-1/2° off perpendicular)
- Mount the planets on the nails in order that they will rotate freely. A light might be placed in the middle to represent the sun.



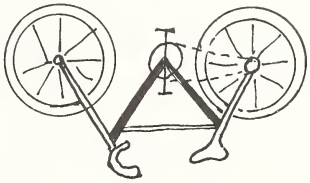
Use your model to:
— explain rotation and revolution to a friend.
— explain the cause of night and day on the planets.
— explain the causes of the seasons on Earth.

The Earth in Space, Activity Card 3

GRAVITY — A Pulling Force



Gravity is a force that makes it possible for us to live on the surface of a spinning planet.



An investigation to try:

1. Set a bicycle in an upside down position.
2. Attach a ball of plasticine or soap to the outer edge of the back tire.
3. Start the back wheel turning slowly. The ball of plasticine will cling to the turning wheel.
4. Increase the speed of the turning wheel. What happens to the ball of plasticine?

5. Try this investigation again. This time locate several balls of plasticine along the edge of the wheel. What happens?

Questions for discussion:
Why do we not fly off the rotating earth?
How does our knowledge of the pull of gravity help us explain why the moon stays in orbit about the earth?

The Earth in Space, Activity Card 4

EARTH ⟷ MOON

Consider the size of the earth and moon and the distance between them to scale.

1. Using the scale 1 cm : 1000 km, cut out circles to represent the earth and the moon.

		Scale Distance
Earth's diameter	12 800 km	
Moon's diameter	3 540 km	
Distance moon-earth	384 000 km	

2. Locate your scale model of the moon the appropriate distance from the model of the earth. If possible show how the moon orbits the earth.
3. Find answers for *at least two* of the following:
   — If the gravitational pull of one object on another is proportional to the mass of the two objects, what can you say about the pull of the earth on the moon compared to the pull of the moon on the earth?
   — Determine what you would weigh if you were on the moon.
   — Tell the class how the moon causes the tides in the large bodies of water on the earth.
   — Does the sun influence the tides on the earth?

The Earth in Space, Activity Card 5

ASTEROIDS — COMETS — METEORS

Using the information found on pages 208-217 and in references noted in your reference file, complete the chart below.

	ASTEROIDS	COMETS	METEORS
composition			
movement			
origin			
most famous			
size			

Information compiled by: ____________________

The Earth in Space, Worksheet 1

SUN SURVEY

Person Surveyed: ____________________ No. ________

Check (✓)

A parent ________ A friend ________ A relative ________ Others ________

QUESTIONS TO ASK:	RECORD ANSWERS HERE:
1. What is the sun?	____________________
2. How far away is the sun?	____________________
3. What elements make up the sun?	____________________ ____________________
4. What does the sun give us?	____________________
5. What is the approximate surface temperature of the sun?	____________________ ____________________ ____________________
____________________	____________________
____________________	____________________
____________________	____________________

Survey conducted by: ____________________

The Earth in Space, Worksheet 2

COMMUNICATION SATELLITES

Research

Research two communication satellites that are presently orbiting the Earth. Provide the following information:

COMMUNICATION SATELLITE

Name of satellite: ______________________

Launching nation: ______________________

Date launched: ______________________

Purpose of satellite: ______________________

____

Other information: ______________________

____

Information compiled by: ______________________

COMMUNICATION SATELLITE

Name of satellite: ______________________

Launching nation: ______________________

Date launched: ______________________

Purpose of satellite: ______________________

____

Other information: ______________________

____

Information compiled by: ______________________

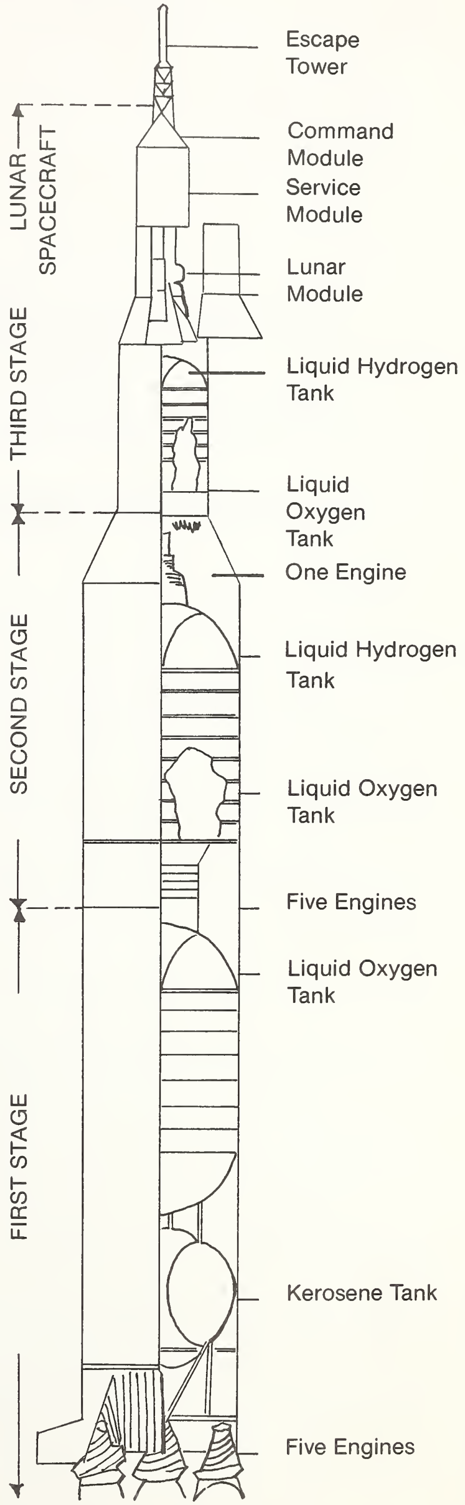
APOLLO 11 — LUNAR LANDING

Day 1

9:32 a.m.	Apollo 11 lifts off launch pad.
9:35 a.m.	The first stage separates and the second stage ignites.
9:41 a.m.	The second stage separates and the third stage ignites sending the spacecraft into orbit about the earth.
12:16 p.m.	The third stage re-ignites and sends the spacecraft out of orbit towards the moon.
12:49 p.m.	The command module and the service module separate from the lunar module.
12:57 p.m.	The command module and service module having turned end for end dock with the lunar module.
1:49 p.m.	The third stage separates from the spacecraft.

Day 4

1:21 p.m.	The spacecraft goes into lunar orbit.
1:45 p.m.	The lunar module separates from the service module.
4:17 p.m.	The lunar module lands on the moon.
10:56 p.m.	Neil Armstrong sets foot on the moon.



The Earth in Space, Activity Card 6

SPACE FLIGHT PLAN

Our project name is: ______________________________

Objective of our mission: ______________________________

____

____

PREPARATIONS

1. We will provide a large diagram of the spacecraft we will design for this flight. A cardboard model will be provided if practical.

2. Materials and equipment that might be required during the flight will be listed.

3. Our astronauts will attempt to find answers to these questions during the flight: (List at least three questions)

____

____

____

____

____

____

____

____

Members of our project team are:

______________ ______________

______________ ______________

______________ ______________

______________ ______________

RED BOOK (6)

Unit 6: Ecosystem Earth

Pages 240-281

UNIT DEVELOPMENT

Concept Development

In the preceding levels of the program, the following concepts were introduced and developed:

Everything around us contributes to our environment. Objects and events in the environment can be perceived and described by using our senses. There are living and non-living things in the environment. Living things have certain characteristics and needs. They have structures that enable them to meet their needs.

In this unit, students are introduced to the concept of an ecosystem. An ecosystem is an environment-organism interaction. Living things and the physical environment are continually *interacting*, *adapting* and *changing*. A further concept developed in this unit is that a *delicate balance* exists in an ecosystem. Each living thing plays an important role in maintaining and protecting that balance.

Unit 6, "Ecosystem Earth," consists of three chapters. Chapter one discusses how living things depend upon and are affected by the non-living things in the environment, such as soil, water and energy. Many organisms in turn, affect the non-living things in the environment. Chapter two outlines the interactions that occur among the various living things in an ecosystem. The text considers the relationships in three particular ecosystems: a freshwater ecosystem, a desert ecosystem and a city ecosystem. The third chapter focuses on the need for a balance in an ecosystem. The role that people can play in maintaining and affecting the balance in an ecosystem is presented, in order to develop environmental attitudes in students.

Process Development

The immediate environment of the school should provide many locations or experiences that can be used for investigations that will introduce, complement, or extend the concepts and activities presented in the textbook. You may wish to investigate the school ground and the neighbourhood before beginning this unit, to identify experiences and locations that could be used.

As a result of the activities in this unit, students *observe* living things under certain environmental conditions, and the effect of some pollutants on the environment. They make *comparisons* based on one or two *variables*, *infer* trends or *predict* effects of changes. They also carry out simple, systematic *experiments* to test *hypotheses*.

Students begin the unit by trying to *simulate* soil formation (page 246). They then *investigate* a freshwater ecosystem (page 255), a city ecosystem (page 263), and a vacant lot (page 266). This is followed by two *investigations* on the effects of pollutants on ecosystems—smoke (page 275), and phosphates (page 276).

Related Units

Living Things	*Orange Book (1)*
Food for Animals and You	*Gold Book (2)*
Environment	*Gold Book (2)*
Animal Behaviour	*Blue Book (3)*
Water in Your Environment	*Blue Book (3)*
Animals and Their Environment	*Brown Book (4)*
Interacting with Your Environment	*Red Book (6)*
Ecology: Interaction in the Environment	*Exploring Living Things (7)*
The Earth: Its Nature and Importance to You	*Exploring Earth and Space (7)*

Materials and Advance Planning

The following list includes the materials that a student, or in some cases a group of students, will need to carry out the activities in this unit. In some instances, other materials may be substituted for those on the list.

Small rocks of different kinds; coffee can with lid; small seeds such as radish or mustard seeds; can of garden soil; widemouthed 4 L jar; sand; aquarium plants; guppies or goldfish; fish food; snails; potting soil; large clay pot; string; bucket; metre stick; paper towels; several grasshoppers or other harmless insects; 2 small potted plants; four 4 L jars with lids; 10 small pieces of incense; matches; pond water with algae; phosphate fertilizer; 2 glass jars; tablespoon.

The additional activities suggested in the resource guide require: 1 L jar; large spoon; paring knife; hammer; aquarium (plastic or glass); dog food; mealworms; mesh to cover aquarium; potting soil; sand; variety of cacti; gravel; glass dish (7 cm deep); bread crumbs; bottle of nail polish; molasses; honey; clipboard; stopwatch.

BACKGROUND INFORMATION

Chapter 1: Nonliving things in an ecosystem, pages 242-252

It may be surprising to your pupils that nonliving things can be as important as living things in affecting the well-being of an ecosystem. An animal depends on plants or other animals for its food. But these plants and animals upon which the animal feeds require certain nonliving things, including soil, water, air and energy, or they will not grow and reproduce.

Only a few nonliving things that affect living things could be considered in the text. Obviously there are many more. One rather comprehensive factor, which includes many important nonliving things that affect each ecosystem, is the climate. Climate has profound effects on living things. It can affect their colour, their reproductive cycles and their behaviour. The dominant features of climate that affect living things are light, temperature, wind, rainfall and humidity. These factors help make up the physical environment of organisms.

Changes in the amount of light available to an organism may change the pattern of important functions in its life. Certain plants, such as soybeans, produce flowers only when the hours of daylight are short. Other plants, such as spinach, produce flowers when the hours of daylight are long. Animals are also affected by light. Many animals migrate because of changes in the light in their environment. Seasonal changes of colour in the feathers of some birds and in the fur of some mammals are also affected by the light intensity and the length of the days.

Temperature is another climatic factor that affects living things. Most organisms are active between 0° C and 40° C, but some species can function outside this temperature range. Some dormant bacteria can survive at -75° C, and certain algae can endure hot springs at temperatures of 92° C. Chemical reactions within living things progress more rapidly at higher temperatures and slow down or stop at very low temperatures. This explains why certain animals are active in summer and hibernate in winter. Often it is not the average temperature that an ecosystem has that determines which organisms can live there but rather the changes in temperature within one day, from day to day, or from season to season.

It has been demonstrated that when one factor in the physical environment is not at an optimum level, tolerance to other factors may be reduced. For example, when the water temperature falls, certain ocean animals become less tolerant to any drop in the salinity of the water in which they live. When the temperature is warmer, these same animals are tolerant to much greater reductions in the salinity of the water.

Chapter 2: Living things in an ecosystem, pages 253-267

Besides the feeding relationships that living things have with one another, there are other complex interrelationships that are often established in an ecosystem. Living things even affect the nonliving things in the ecosystem, often causing appreciable changes in the physical environment, as happens when beavers build a dam. In addition to this example, mentioned in the text, even bacterial activity can affect an ecosystem in many ways. For instance, when debris from some kinds of industry or from the runoff from adjacent farmlands enters a freshwater ecosystem, it can change many parts of the ecosystem. In time, bacteria can break down the products contained in these waste materials. These products often contain proteins, sulphur compounds, and cellulose. Certain bacteria can break down the proteins into simpler compounds, such as nitrates and ammonia. Other bacteria can change sulphur compounds to sulphates or change cellulose to simpler carbohydrates. These end products then serve as nutrients for plants and animals in the ecosystems, causing them to flourish.

Since all living things require varying amounts of water, the amount of water available in an ecosystem affects the kinds of living things that can survive there. A freshwater ecosystem naturally provides an ideal environment for plants and animals that require large amounts of water to survive. On the other hand, because they need little water, insects and reptiles are suited to living in a desert ecosystem. Of the mammals, rodents do well in the desert because of their size and their economical use of water. Among plants, mosses survive in the desert because somehow they can survive desiccation, or drying out. Some other desert plants avoid drying out by having small leaves that reduce transpiration or by having succulent leaves that store water.

Besides providing different amounts of water for the organisms within their confines, freshwater ecosystems differ in another way from other ecosystems. If a freshwater ecosystem is large enough, it is not subject to sudden temperature changes and provides a suitable habitat for both plants and animals. Cold-blooded animals, such as fish, might not be able to survive sudden fluctuations in temperature.

Plants and animals that live in a desert ecosystem must be able to cope with extreme changes in temperature. Daytime temperatures as high as 50° C are common in some hot deserts of the world, such as the Sahara. At night the temperatures may fall to 0° C or less. In addition, cold deserts, such as the Gobi, have very severe winters. Desert animals are able to survive such extremes.

Plants and animals in a city ecosystem often have to struggle against fluctuations in temperature, too. Many large cities of the world are located in the northern part of the temperate zone, where drastic changes in temperature occur. During winter, the trees in these areas lose their leaves and subject themselves to a period of dormancy. City animals, such as squirrels, become inactive during the cold weather. Even the life cycle of many city insects is slowed down during winter.

Chapter 3: Balance in an ecosystem, pages 268-277

For all practical purposes the total amount of matter on the earth is fixed. Scientists refer to the earth as a closed system, meaning that no matter enters or leaves. (The amount of matter represented by incoming meteors is negligible.) To maintain the amounts of certain important substances on the earth, these substances must be cycled and recycled throughout all ecosystems. Chemicals, such as carbon, oxygen, nitrogen, water and phosphorus, are recycled, using the sun's energy.

Carbon is the basic building block necessary for life. All life on the earth is based on carbon compounds. The source of carbon for plants is the carbon dioxide that makes up less than one percent of the atmosphere. In the process of photosynthesis, which occurs when chlorophyll and light are present, carbon dioxide combines with water to form sugar, oxygen and water.

The recycling of these products occurs during respiration, when sugar is broken down after combining with oxygen, releasing carbon dioxide, water and energy. Thus two interdependent processes, photosynthesis and respiration, work together to achieve a balance of certain important substances for living things.

Even though there is an efficient water cycle constantly returning water from the atmosphere to the earth, about 70 percent of all fresh water is locked up in glaciers and cannot be used by living things. Scientists are studying the feasibility of transporting icebergs from Antarctica to desert regions of the world where the water distribution is unbalanced, such as in the Middle East. Such huge supplies of fresh water from these icebergs might help convert some of the desert land of the world into productive farmland.

As shown in the text, when one species of living things increases in number, checks within the ecosystem itself often cause a balance to be achieved again within a short time. However, people are often not affected by such checks. People must impose their own checks to maintain a balance in the ecosystem when they find that their cars are polluting the air or that their hunting is endangering a species of animal. They do this when they protect the environment from pollution and when they conserve the wildlife in their area.

TEACHING STRATEGIES

The purpose of the following activities and teaching strategies is to provide you, the teacher, with a wide variety of suggestions that can be used, together with the material presented in the textbook, to help develop the processes and concepts of this unit.

Chapter 1: Nonliving things in an ecosystem, pages 242-252

— Pages 243 to 246, Soil, can be read and discussed.

— A science centre entitled Nitty Gritty Dirt could be set up for this section of the unit. The following activities could be carried out in this centre: "Finding Out," page 246 — a worksheet is available in the ACTIVITIES FOR EXPLORING SCIENCE book (page 41).

— "Activity Card 1, Soil — A Natural Resource" encourages students to examine soil for colour and texture of soil. This card includes a field trip to a gravel pit to study the depth of soil layer and the underlying layers. You may wish to obtain the owner's permission to enter the site. A section also is included whereby children interview the owner of the gravel pit. This could be done on the site or, in the classroom.

— Pages 246 to 248 related to water can be read and discussed.

— The science centre's focus could be changed to read "Water, Water Everywhere!".

— Discussion could be held about the distribution of water on the globe. What is water? Other points to consider:
  — Compare the percentage of water and land on the globe.
  — Importance of water to world's communication
  — Importance of water to world's trade in agricultural products
  — How water could be a hindrance to an ecosystem
  — Benefits of water to cities
  — Kinds of ecosystems e.g. freshwater ecosystem, saltwater ecosystem

— "Worksheet 1, Using Water" asks students to think about and/or research the various uses for water throughout the world by nature and man. The activities fall into the general categories:
  (a) the necessity of water
  (b) the acquisition of water
  (c) how we use water

Answers:
Droplet #1 — deserts, polar ice caps

#3 — Cools body; use for drinking; water is a medium which carries wastes from body; is one source of minerals to body.
#4 — Near a large water source e.g. lake, river or ocean
#6 — Water to drink
bathe and shower
cooking purposes
use on plants and lawn
wash away human wastes and dirt
use in industry
produce power
provide cheap transportation in shipping
#7 — Toronto — on Lake Ontario; shipping, fishing
Montreal — on St. Lawrence River; shipping

Vancouver — on Pacific ocean;
shipping, fishing,
logging coal port

#8 — Provide irrigation, produce hydroelectric power, flooding dry areas, industrial uses, etc.

#9 — Ganges River is considered a sacred river by the Hindus. Bathing

— Pupils could brainstorm methods of collecting and distributing water to land and plants:

e.g. streams, lakes, rivers
water towers
dikes, canals, ditches
water trucks
large areas of soil covered with plastic
irrigation pipes from streams, lakes and rivers
water sprayers
natural water holes
electric pumps to pump underground water
artesian wells
collection basins for rainwater.

— The class could then peruse filmstrips, films, pictures, books, etcetera to see these methods in action.

— You could visit a water purification plant in your area. What happens to sewage water?

— When your class studies the concept of minerals in water, you may wish to draw their attention to the stalactite and stalagmite formations that occur in limestone caves. Some may have heard of, or visited, these sites and collected post cards. If interested they could research the difference between stalactite and stalagmite formations and read about the following sites:

The Carlsburg Caverns in New Mexico
The Luray Caverns in Virginia
Mammoth Cave in Kentucky
Nahanni in Northwest Territories
Castleguard in Alberta
Brag Creek Ice Cave in British Columbia
Warsaw Caves in Ontario.

— You might wish to discuss "spelunking". You could ask students why the general public cannot enter stalactite areas — only official groups of spelunkers.

— Pages 248 and 252 can be read and discussed.

— Launch some balloons! The class could have a balloon race. The purpose would be to discover how far helium-filled balloons travel when released. Each balloon would carry a post card with the name and address of the student who launched it. The back of the post card could contain a short message (1) to explain their study of wind energy in this science unit (2) to ask finder to report where the balloons landed and (3) to ask finder to note any unusual places where they might have landed (e.g. in trees, in a barnyard). The card should also list the name of the sender and their address.

Students could plot balloon destinations on a map of local area, province and/or Canada. (Some balloons have travelled over 3 provinces!)

This activity could include (a) a study of map directions (b) kind of ecosystem it left, perhaps crossed, and the type where it landed (c) a reminder that seeds of plants can be carried by wind, sometimes very long distances.

— The novel Twenty-One Balloons by William Péne du Bois is about a math professor who decides to fly in his balloon for a year. However, a curious seagull ends his flight and the professor lands on the Island of Krakatoa. Students could discuss the ecosystem on this island, the way the residents coped with the active volcano and then make a variety of balloon craft.

— The purpose of "Worksheet 2, Raindrops Keep Falling" is to show students that rain can change the behaviour of animals within an ecosystem, the reasons why they change behaviour and in some cases, the results of their behaviour.

Answers:

#1 — Answers will vary
#2 — Wet fur makes them cold
#3 — Spread oil from gland at base of tail on feathers to make them waterproof.
#4 — Insects
#5 — Wings tear easily when wet.
#6 — Insects fall into lake or river and fish catch them on water's surface.
#7 — Perhaps because of noise of storm, an attempt to keep dry; Get electrocuted if tree is struck by lightning.
#8 — Ants don't build nests in areas that flood easily. They live in higher areas.
#9 — By turning over, each ant gets a chance to breathe.
#10 — Raindrops break up surface of water and makes it harder for fish to see fisherman.
#11 — Butterflies and moths have scales and a very thin layer of wax on wings.

Energy, page 250-252

— Discussion could centre around the idea that man has used sunlight in the past in the preservation of foods and to provide shelter and clothing:

e.g. — native people preserving salmon and berries
— early native people drying skins for shelter
— the Inuit drying skins to make mukluks
— early pioneers used dried animal skins as blankets to keep warm when travelling.
— early gold prospectors killed animals for food and used dried skins for clothes and pokes
— use of sun to dry clay bricks for homes in some parts of Mexico and Africa.
— use of camels in desert areas to withstand heat.

— As an extension of Exploring on Your Own (page 251), students could design and create a house model that utilizes solar energy. If desired, the design could be drawn to scale to integrate mathematics. It is suggested that they work in groups. They could include in their design a concise explanation of how the solar model works. On completion, they would be presented to the class. The class then could discuss the models and choose the best developed and most feasible design. Prizes could be awarded.

- Several songs mention "sun" in their words. The class could sing these and study how the word "sun" is being used.
  e.g. "You Are The Sunshine of My Life"
  by Stevie Wonder
  "Sunshine on My Shoulder" by John Denver
  "Roses Love Sunshine" by Nana Mousskouri
  "Turn on the Sun" by Nana Mousskouri
- A giant montage could be made using the letters S U N. On the letters poems or sun facts could be printed together with pictures of the sun collected from magazines.
- "Worksheet 3, What would happen if.....?" invites students to speculate about changes related to nonliving things in an ecosystem. Students would choose any 3 of the questions to answer but it should be stressed that precise, quality answers are expected.
- "Activity Card 2, Energize Me" has been designed to encourage students to create projects to show various forms of energy of living and nonliving things. There are 15 suggestions. Perhaps you might wish to limit the number of people making a particular project i.e. two groups per project. In this way a greater variety of projects can be displayed and demonstrated. Each project requires some form of actual energy.

Chapter 2: Living things in an ecosystem, pages 253-267

- Pages 253 to 257, Interactions in a freshwater ecosystem, can be read and discussed.
- A field trip can be taken to a local creek and students can collect algae growing on rocks in a pond or stream. It should be placed in clear pond water so that they can examine the algae with a hand lens.
- A worksheet for "Finding Out", page 255 is available in the ACTIVITIES FOR EXPLORING SCIENCE book on page 43.
- You could have a discussion about the value of the beaver using these points:
  (a) Beavers share man's ability to alter the landscape
  (b) The beaver's pond provides a food web
  (c) Disadvantages of beavers
  (d) Beavers as aquatic engineers — dam builders
  (e) Beavers as a natural resource
- "Activity Card 3, Crayfish Hunting," asks students to collect crayfish and to observe their feeding habits and reactions to new foods. Students are instructed to make a booklet covering its characteristics, its habits and its food. A page of research questions is included.

  Answers to questions from left to right:
  Row 1 — Body is divided into sections or segments. Abdomen, legs, pincers, feelers move. Uses claws to capture and hold prey.
  Row 2 — Most active at daybreak or nightfall. Remain in burrow rest of day. It eats snails, small fish, tadpoles, young insects.
  Row 3 — Yes, mostly
  It can regenerate new leg, eye or claw
- Pages 258 to 262, Interactions in a desert ecosystem can be read and discussed.
- Various activities could follow a film related to the desert. Students could (a) classify the living and nonliving things seen in the film (b) make a food web and (c) note how people dressed for a desert climate.
- The class could view a film related to the living and nonliving things in a desert ecosystem. They could draw a desert scene and record what they consider the most important ideas from the film. These scenes can be mounted on the bulletin board.
- "Activity Card 4, The Desert Comes to the Classroom", gives instruction to students on how to make a miniature desert garden. These gardens could be a special gift to parents, at the culmination of this unit of study.
- A mapping session would have students mark on a world map the various desert areas of the world. Each area could be coloured a different colour and noted in the legend of the map.
- "Activity Card 5, Desert Life" relates to a number of different desert scenes throughout the world. Fifteen scenes have been outlined which gives a very wide variety of choices. It is suggested that only two people create any one scene to give a greater variety of presentations later. It is the task of the student to make a model to include living and nonliving items co-existing in a natural state. Some of the activities refer to specific areas in the world, others are general. The students will need to research for details specific to these areas. A write-up should be included with their model. Their models should be as authentic as possible.
- "Activity Card 6, Man Fights Back and Wins", gives students examples of how man — in various areas of the world — has turned a bleak desert into a viable desert. It is suggested that they make models to show these advances in technology. These projects challenge your students to have these projects actually work!
- Discussion statement:
  "People who must survive today, do not worry about tomorrow."
  (a) In what ways does this statement apply to desert dwellers?
  (b) Where, in the world, do you think this statement would be most applicable?

- This problem could be posed to the class:

  Cattle symbolize wealth to nomadic herdsmen of desert areas. Therefore, they do not wish to limit their herds.

  What alternatives could they use and accomplish the same end — wealth?
- Pages 262 to 267, Interactions in a city ecosystem, can be read and discussed.
- A worksheet for "Finding Out" on page 263 is available in the ACTIVITIES FOR EXPLORING SCIENCE book (page 45).
- Pupils could analyze the different types of soil in their city ecosystem.

  e.g. rich, fertile soil in their gardens
  less fertile soil beside roadways
  damp, dark soil in greenbelt areas
  kind of soil for soccer fields and parks
  lack of soil in business section
- Students could break into groups and brainstorm the different kinds of plants and trees you would find in various areas; this information can be put on charts.

  e.g. a shopping centre or business area
  a park
  a greenbelt
  around the school
  in a wooded area by a stream

  Later, the whole class could analyze the information — Do they vary in number for each area? Which area had the most trees and plants? What factors make them vary in number?
- A series of field trips could be planned to different areas and students could record destructive and constructive changes they see in their own ecosystem.
- Students could teach a lesson about a current events issue in your community. A few suggestions:
  - (a) how plants are affected on the busiest street in your city.
  - (b) local parks being hemmed in by residential areas and the result.
  - (c) noise pollution from a print shop affecting the pet store next door.
  - (d) overpopulation of pigeons in downtown area.
  - (e) flights from airport disturbing the small birds in the area.
  - (f) effect of water pollution on freshwater ecosystem.
  - (g) city spraying has affected the humming-bird population and drastically reduced their numbers.
- Students could take photographs of trees they find in various areas within their city ecosystem. e.g. near rivers, streams, lakes; around school; in downtown area; in parks; in industrial areas.

  When the photographs are developed, the pictures can be mounted and analyzed.
  - Is there one type more than others in each area?
  - Which type of tree is seen in all the areas?
  - Are there more evergreens than deciduous trees?
- A small group of students could enquire at city hall if (1) there are any regulations about planting or cutting down trees in your area. If so, what prompted these regulations? (2) Are there by-laws or incentives requiring large factories to provide green areas and/or to landscape their property?
- A worksheet for "Finding Out", page 266 is available in the ACTIVITIES FOR EXPLORING SCIENCE book (page 46).
- "Activity Card 7, Ants" affords students an opportunity to study the behaviour of ants in the environment and then asks students to consider ways of controlling ants in unwanted areas (e.g. gardens, houses), using the information they gained through observation.

Chapter 3: Balance in an ecosystem, pages 268-277

- Pages 269 to 271, Balance of nonliving things, can be read and discussed.
- "Activity Card 8, The Polluters vs. The Law" give students experience in courtroom procedure related to a case involving water pollution. Students can volunteer for character roles and the rest of the class can be the jury. Sufficient time should be given the court room group to develop their case. (You may have to familiarize this group with the courtroom layout, role of personnel and how to present a case.) Following the trial, the jurors and judge can discuss the case on the merits of the evidence. The verdict should be addressed to the company (not the individuals).
- Students may wish to devise a second court case related to air pollution in which a factory's smokestack emits harmful gases to plants. The vegetation turns black and the animal population of the area is in jeopardy because of lack of food.
- A third case could relate to a farmer who has leased his farm to a government agency. They had a written agreement that this agency would rotate the crops so that the soil would remain fertile. They also agreed to plant beans, clover and peas to restore the nitrates in the soil. The lease has expired and the farmer has discovered that the above agreement was not carried out. The land has become infertile. The farmer is suing the government for damages to his land.
- Pages 272 to 273, Balance of living things, can be read and discussed.
- Pages 273 to 277, People in an ecosystem, can be read and discussed.
- "Worksheet 4, Life in Prairie Dog Town", gives students information about the prairie dog's life and the early pioneers' attempts to eradicate this animal. It requires students to make a model of the animal's burrow within a grassland ecosystem and to consider the beneficial influences they exert in this system.

  Answers for Life in Prairie Dog Town
  Enemies — coyotes, rattlesnakes, burrowing owls

Farmers get upset because a running horse or cow that steps in one of their holes may break a leg. Beneficial influences — loosen soil by digging, eat weeds.

— Discussion could centre around the usefulness of air in the maintenance of a healthy ecosystem. You may wish to include a film about air. The students then could move to the science centre, help themselves to a balloon, blow it up and make a personal statement on it regarding air pollution. Their comments can be written in ballpoint or felt pen. These balloons can decorate the classroom, or be displayed in the main foyer of the school.

— Panel discussion topic: "Will man always make provision for nature's wild creatures and plant life?" A moderator can volunteer to conduct this panel. He/she could set a time limit and then allow the class to add their views. At the end, the class can vote on whether or not they think man will make provision for nature's wild creatures and plant life.

— "Worksheet 5, Caribou of the North" draws students awareness to the results of man's activity towards land development and how this development affects the habits of the caribou in Canada's North.

Answers for Caribou in the North
Nomads: hardy animals that move about the landscape. Natural Factors: disease, heavy snow conditions, hunting, drowning in rivers and insects.
Alpine plants: Browsers do not pull plants from the ground when eating, therefore the plants would remain and possibly reproduce.
Food: sedges, tender shoots of grasses, willow shoots and leaves of dwarf birches, horsetail and mushrooms in summer; lichens in winter.
Iron Dogs is another name for snowmobile.
Will oil, tundra and caribou mix? (Answers will vary.)
Animals involved: bear and caribou
Dwindled harvest: Hunters' bag limits protect herds; snowmobiles are replacing sled dogs, therefore fewer sled dogs to be fed moose meat in villages.
Movement: It will change their grazing patterns or areas; other structures are highways, bridges and railroads

— "Activity Card 9, Stamp Out Pollution" asks students to adopt the role of an advertising agency to produce posters related to air, noise and water pollution caused by people. These posters can be displayed on school walls.

— Discussion could centre on the modes of transportation in your community and province, and on the advantages to the ecosystem. Students could be asked to design a form of public transportation that might operate for future generations minimizing pollution problems or damage to the ecosystem. Would this system be built above or below ground? What kind of energy will be used to run it?

— Charts could be made to show pictures of different kinds of transportation that create problems in an ecosystem and those that do not create problems. Different kinds might include — mopeds, canoes, surfboards, trucks, campers cars, airplanes, bicycles, sailboats, power cruisers, hangliders, parachutes, streetcars, gas, electric or diesel buses, tankers, trains, barges, ferries, rollerskates, rollercoasters, gliders.

— A large circular gameboard could be made and divided into quarters. Students could locate pictures related to air pollution, water pollution, noise pollution and perfect landscape conditions. These pictures could be glued onto the appropriate quarter of the circle, in collage fashion. Four cards would be made for each kind of transportation listed above. The cards would be shuffled between players. Each student would take a turn at placing a card in a particular section of the board. At the end they can analyze which cards are in more than one section and thereby realize that some kinds of transportation create a variety of pollution in an ecosystem. (Some cards will not apply to every category so there may be some left over.)

— A panel discussion could focus on the use of the SST and other related fast types of transportation and the effect that they have on animals and people.

— A worksheet for "Finding Out", page 275, is available in the ACTIVITIES FOR EXPLORING SCIENCE book (page 47).

— Pages 275 to 278, Keeping the balance, can be read and discussed.

— A worksheet is available for the "Finding Out," page 276 in the ACTIVITIES FOR EXPLORING SCIENCE book (page 48).

— Students could conduct a traffic survey to analyze types and amounts of traffic in your area. Groups of children could collect data at 8 a.m., 10 a.m. and 12.15. Students would then return to the school and prepare graphs to record their information. Analysis of data gives students information about (1) the type of traffic in their community and (2) the heaviest traffic time. See "Activity Card 10, Traffic Survey Data Sheet and Traffic Analyst".

— Representatives of S.P.E.C. and/or S.P.C.A. or a game warden could visit the classroom to explain their role in keeping a balance in an ecosystem.

— If any dam construction or nuclear plants have been completed in your area, students could visit and interview officials about the impact of these structures in future on the ecosystem.

— Please see 'Extending the Finding Out' page 276.

SOIL — A Natural Resource

Soil is the covering over most of the land surface of the world. It is composed of rock and mineral particles as well as living things and their remains. Soil is the thin layer of material on the earth's surface that will allow growth of plants. Soil is considered to be one of the most important natural resources of a country. Canada, as a whole, is fortunate to have good soil. Because of our good soil we can produce:

- lumber
- fruit and vegetable crops
- rich grazing lands for cattle and sheep
- grain crops

It takes a long time for soil to form. You may be surprised to know that it takes hundred of years to build up 2 cm of topsoil. It also depends on the weather of an area. In areas where it is very cold, soil is very slowly built up — if at all! However, if the climate is moist and warm it takes less time for soil to develop.

Colour is one characteristic that is first noticed about soil, and it can tell much about how the soil was formed and its content. Soil colours range from white, through brown to black. If the soil is black, you know that it contains a great deal of *humus*. Humus is decomposed organic matter. Canadian soil tends to range from black to brown. Desert soils are usually light brown to gray because they have very little humus. Red soil tells us that small quantities of iron may be in the soil or it may be red shale or sandstone and that the soil is well drained. A whitish soil in dry climates may have deposits of salts in the soil.

What is the colour of soil in your garden at home?

What does that tell you?

Visit a gravel pit. Gravel pits tell a story. They can tell you how the various sizes of rock and sand settle or how deep the soil layer is that supports plant life.

You will need: green, brown, black, and gray pencil crayons
a plastic bag
this sheet
a clipboard
field glasses to be used by three people

- Look at a section of the gravel pit. You will probably notice that the cross-section (area excavated) is made up of layers. The top layer will be perhaps a thin layer of soil. Estimate the depth of the various layers. (You may not see all of these layers in the pit.) Use the chart to record your estimates:

LAYER	ESTIMATED DEPTH	DESCRIPTION OF THIS LAYER
Top Layer		
2nd Layer		
3rd Layer		
4th Layer		
5th Layer		
Base		

Ecosystem Earth, Activity Card 1

What is the difference in texture between the top layer and the base layer?

- Walk up fairly close to the cross-section. (Do not attempt to climb this section as there may be loose material and you might lose your footing!)

Where have the sand particles settled?

- Try to find out who the owner is. Perhaps he will meet your class and discuss some of the following items:

Why has the owner chosen this section of land as a gravel pit?

What types of gravel are taken?

How is this gravel used?

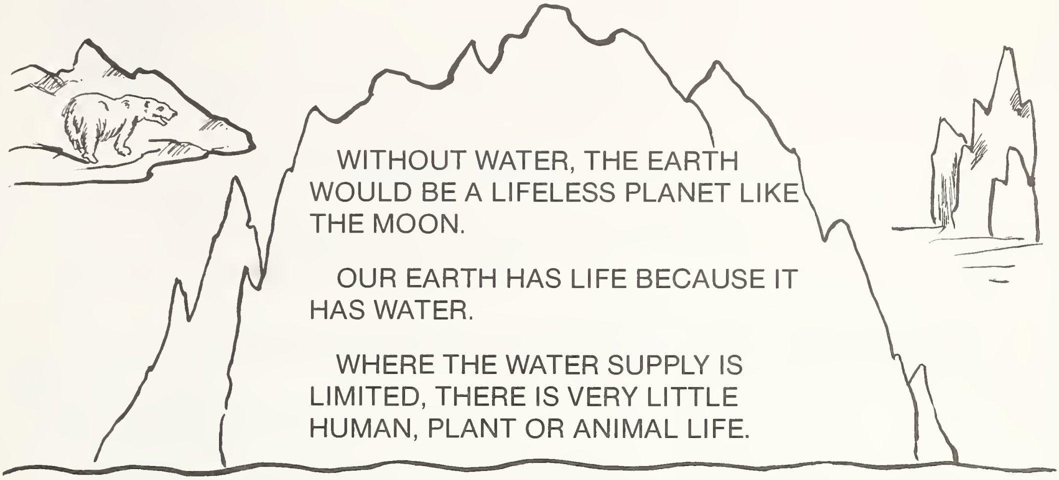
If machinery is in the pit — try to find out the names and uses of the machinery.

Does the owner plan to restore this pit area with some form of vegetation to prevent erosion?

- Sketch a picture of this pit showing the vegetation of the area and the various layers in the pit.

Ecosystem Earth, Activity Card 1 (continued)

USING WATER



WITHOUT WATER, THE EARTH WOULD BE A LIFELESS PLANET LIKE THE MOON.

OUR EARTH HAS LIFE BECAUSE IT HAS WATER.

WHERE THE WATER SUPPLY IS LIMITED, THERE IS VERY LITTLE HUMAN, PLANT OR ANIMAL LIFE.

1. Can you think of 2 general areas on earth that have very little life?

____

____

2. About three quarters of the earth's surface is water. Make a circle graph to show this fact.

3. Think of 4 reasons why water is essential to a person.

4. Look at a population distribution map of Canada. Why do you think there are more people living in certain areas?

Ecosystem Earth, Worksheet 1

USING WATER (continued)

5. Where do we obtain our supply of drinking water for this area?

6. Can you think of 6 reasons why man needs water in a city?

7. Large cities have developed near large water suplies (rivers and lakes.) Where are these cities located and how is this water used for commercial purposes?

8. How has water been made to work for man?

9. The water of the Ganges River (India) is used for drinking, washing, transportation, washing clothes, etc. Its water has spiritual value. In what way? How is it used for this purpose?

10. Planet Earth is becoming overcrowded. Suppose that we began to inhabit the moon! How could man's need for water be accommodated?

RAINDROPS KEEP FALLING...

Most humans want to get under cover during the rain. What do animals do in the rain? Some prefer to take shelter, some must take shelter, some leave their shelter, while others stay where they are! They do this for various reasons. Rain is good for them sometimes, but bad at other times.

Why do these animals and insects react to rain the way they do?

1. Elephants, horses and cows usually stay where they are in a light rainfall. Why do you think they do this?

3. Ducks don't mind a little rain. They don't get their head wet either! Think of 2 ways that they prepare for rain.

5. Flying insects have a big problem when it rains. Why?

7. Sometimes cows and horses will stand under a tree in a thunderstorm. Why do you think they take this kind of shelter? How could this be a disadvantage to them?

9. During a flood — after heavy rains — some prairie ants cling together in a big ball. The ball turns over and over in the water but very few drown. Why not?

2. Raccoons, opossums, skunks and chipmunks escape to their dens and burrows. Why do they do this?

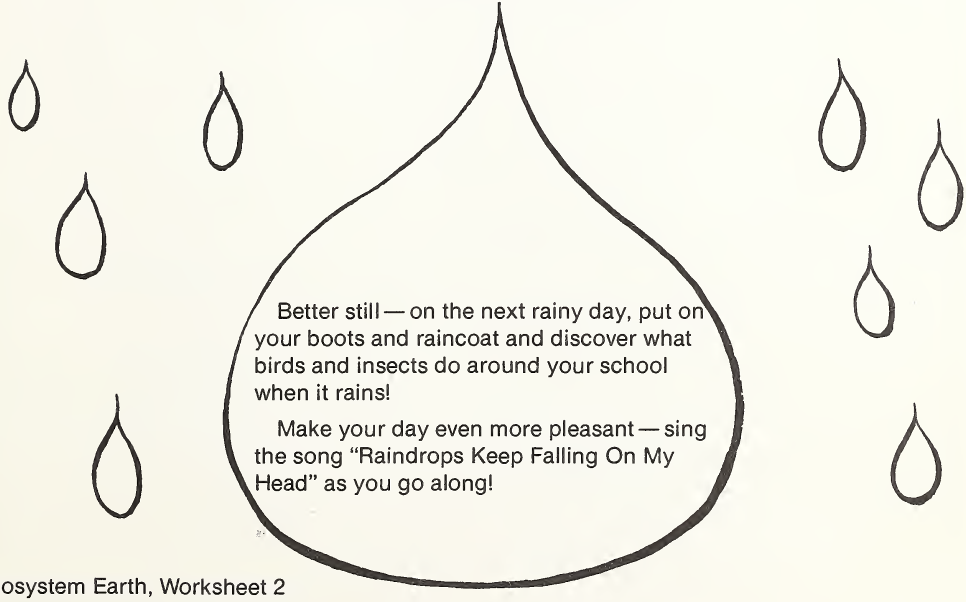
4. Chimney swifts and purple martins fly toward a storm. In fact, they have a banquet in a rainstorm. What would be on their menu?

6. Fish don't mind the rain at all. In fact, they might jump out of the water when it rains! Why?

8. Rainwater collects underground. Ants also live underground. Why don't they drown?

10. Rain is like a magic trick for fishermen. They will fish regardless of the raindrops. Why?

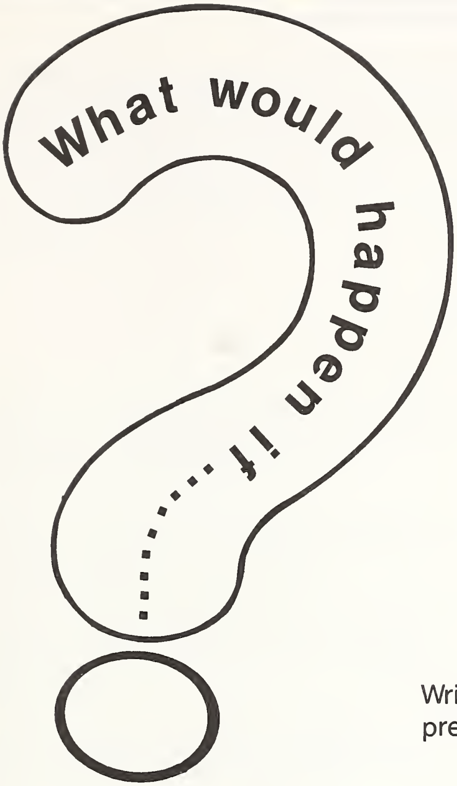
11. Butterflies and moths don't worry about rain. In fact, butterflies can be dunked in a lake or stream and can survive. Why?



Better still — on the next rainy day, put on your boots and raincoat and discover what birds and insects do around your school when it rains!

Make your day even more pleasant — sing the song "Raindrops Keep Falling On My Head" as you go along!

Ecosystem Earth, Worksheet 2


What would happen if ......

CHOOSE ANY THREE OF THESE:

We had a year without sun?

The sun disappeared?

All the water tasted like strawberry juice?

The oceans dried up?

The lava and ash from Mt. St. Helen's destroyed all life for a 200 km radius?

There were no more factories using water?

Rain ceased?

If the earth became covered with water?

The sun never stopped shining?

The earth stopped rotating and Canada was in the direct path of the sun?

Freshwater became saltwater?

Deserts received an excess of rain?

Write down your ideas here. Then prepare a presentation for the class.

1

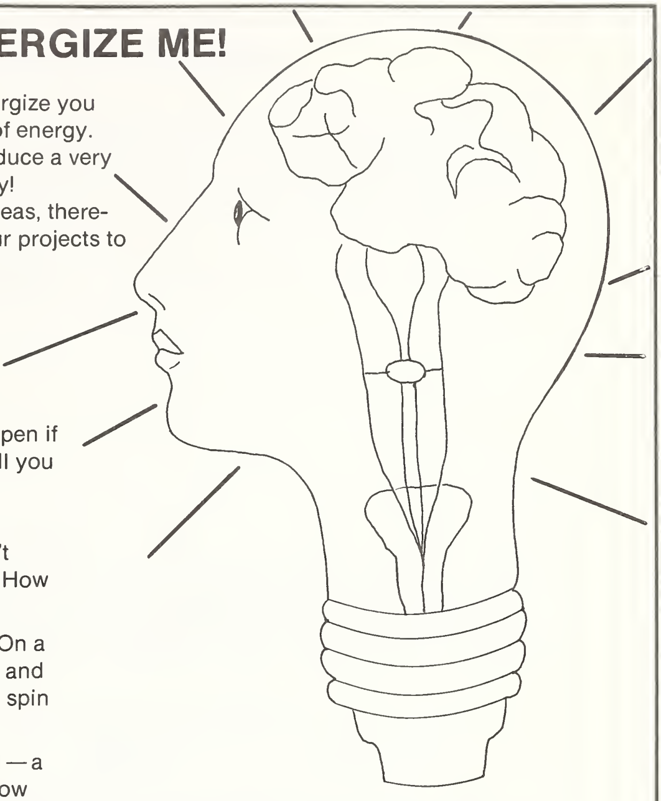
2

3

ENERGIZE ME!

These projects are guaranteed to energize you because they are all related to the use of energy. Besides — they can enthuse you to produce a very unique project that's really full of energy!

Three minds should provide lots of ideas, therefore, work with two friends. Present your projects to the class.



Make a model to show what would happen if the sun never stopped shining. How will you make the sun hot? What else will you include in your model?

Make a cross-section of the earth. Don't forget that the core is exceedingly hot. How will you make it be, or look, hot?

Parts of the world presently lack food. On a large ball show pictures of these areas, and people. How will you make your model spin on its axis?

Make a miniature model of Old Faithful — a geyser in Yellowstone National Park. How will you get the steam to spew out?

Make a volcano of paper mache, using a can for the core. In the can place red food colouring, baking soda & white vinegar for a spectacular display!

Go on a spider hunt! Find a female spider. Put it in a jar, add a twig. Watch it spin a web. Its diet includes flies & mosquitoes.

Make a farm scene with a windmill in it. What will you use to energize the windmill and how will the windmill move?

Make a maze. Get 2 worms or small turtles and race them. Place imaginary bets on a winner prior to the race!

'Hundred Legger' A centipede's fangs & poison glands are energized to capture tiny organisms, including slugs. Try feeding it and watch what happens. Watch their energy level when warm or cold.

Dehydrated foods provide energy for mountain climbers. For the class add water to this food, watch it, and then serve it.

Make up a high energy food pack for a mountain climber. Dress a 'dummy' with a pack and place foods beside the dummy. They can be the actual foods or the containers only.

Follow The Leader! Caterpillars have a tendency to follow a leader. Line up 6 caterpillars. Show the class what happens. Try them on the edge of a glass bowl too!

Helix Hortensis — Snail Helix is an acrobat and will perform for you in a shady spot, in a goldfish bowl. To keep energy high, give him bits of lettuce, dead insects, dry bread, or raw hamburger.

1000 Leggers — Millipedes How many legs? When threatened, millipedes roll up in a ball and squirt a liquid from glands. Collect some — produce a mild threat — and see this energy in action!
Can you smell anything?

Salesman!
Observe ingredients on 3 different types of dog food. Do a commercial explaining why one of these is best. You could use a dog to prove your point!

Ecosystem Earth, Activity Card 2

CRAYFISH HUNTING

The crayfish is a freshwater crustacean and is closely related to the lobster. You will find them in and along lakes and rivers of every continent except Africa. They are various colours — white, pink, orange, brown, dark blue and greenish black. Its unique hard structure serves to protect its body. When the crayfish has outgrown this structure, it is shed and a new one forms. Crayfish are seldom more than 14 cm long.

Here's your opportunity to observe it in its natural environment, discover its everyday cuisine and introduce it to gourmet dining. Have fun!

You will need: an aquarium
minnows
young fly
mealworms
water plants
dog food
snails
ground meat
piece of mesh to cover aquarium.

- Prepare the aquarium to resemble the crayfish's natural habitat. You will need to do some research to get this information. Also check to find out the best time of day to catch one.
- Go off to find your crayfish. Be watching for an "outgrown coat" too. Place your crayfish in your aquarium.
- Let your crayfish sample only *one* of these foods at each feeding:

  minnows
  young flies
  mealworms
  water plants
  dog food
  snails
  ground meat

  Very small quantities are best — you can always give it a bit more if it appears hungry. Remove any excess food to prevent spoilage. Complete the chart after each feeding.

FOOD	REACTION OF CRAYFISH TO FOOD
dog food	
ground meat	
snail	
water plant	
mealworm	
minnow	
young fly	

Which food do you think that it enjoyed the most?

The least?

- Observe your crayfish, thinking about these questions to help you.
  Watch it move. What parts of its body move?
  Watch those claws or pincers in action!
  Note its body shape in general.

Ecosystem Earth, Activity Card 3

CRAYFISH HUNTING (continued)

- Now that you have had an opportunity to watch your crayfish move and eat — try to answer some of the following questions. Some you will be able to answer from your observations, some questions you will have to think about and others will require research. Make a booklet to present your findings.

  How could you make a 3-D crayfish to accompany your booklet? Stir your imagination!

CRAYFISH QUESTIONS

What do you notice about its body in general?

When, in the day, are crayfish most active?

Could you classify them as 'nocturnal' beings?

To what kind of ecosystem does the crayfish belong? Show it as part of this ecosystem, as well as other living and non-living things, in the form of a food web.

What parts of its body move?

What do they do the rest of the day?

It has been said that crayfish can destroy cropland and weaken dams. Is it true? Explain.

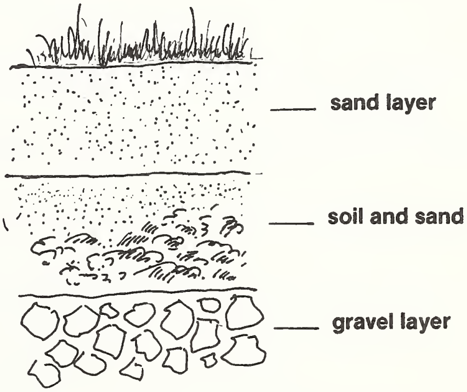
Why does it use its claws or pincers?

What kind of food does it normally eat?

The crayfish won't be upset if it loses a leg, eye or claw in battle. Explain.

Ecosystem Earth, Activity Card 3

The desert comes to the classroom



You don't need to visit the Sahara or the Gobi Desert to see desert plants. Reverse the process. Bring the desert to your classroom!!

You will need: a glass dish about 7 cm deep
potting soil
sand
a variety of cacti
gravel
large can
spoon

- Spread a thin layer of gravel over the bottom of your glass dish. This allows drainage.
- You will have to mix your potting soil and sand in these quantities:
  One part sand with two parts potting soil
- Continue to mix these quantities in your can until you think you have enough to fill your glass dish within 1 cm of the rim. (Cacti have very shallow roots, therefore they do not need a deep layer of soil.)
- To plant your garden, use your spoon to dig planting pockets in the soil and gently place the cactus in the hole. Carefully pack soil around the root of the plant, pressing down to make sure the plant is secure.
- Add a thin layer of sand to the top of the soil to simulate a desert environment. You may wish to add tiny models of desert animals, too.

Enjoy your garden — and water it as suggested in a garden book, that you can get from your library.

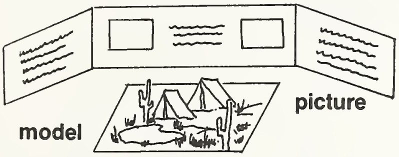
Ecosystem Earth, Activity Card 4

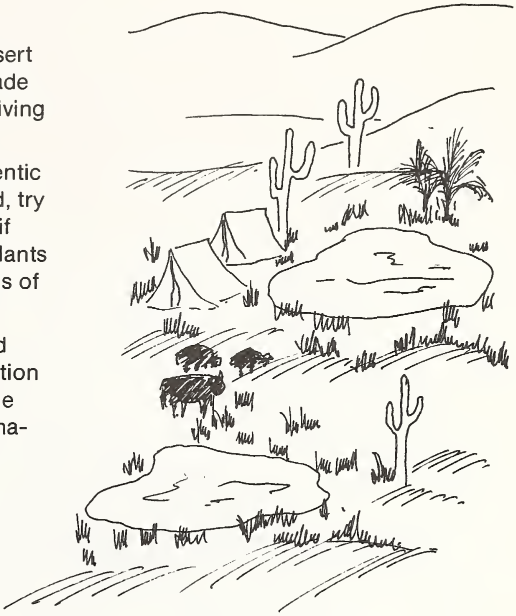
DESERT LIFE

It is your task to create a model to show a desert scene. The following suggestions have been made for you. These models relate to living and non-living things co-existing in a desert.

Try to make the scenes as accurate and authentic as you possibly can. If your scene requires sand, try to use sand! You may want to use actual plants if you have them or you can use artificial desert plants and animals. You could even make paper models of animals if necessary.

It will be necessary to research your topic and record your information. Include in this information how the living things in this model are part of the food web in this ecosystem. Display your information on coloured cardboard together with your model.





Choose ONE of these desert scenes:

— A nocturnal scene showing a few desert animals foraging for food when it is cool. How will you simulate "night"?

— An over-abundant population of dingo in their natural Australian habitat.

— The kangaroo rat eating plants and seeds.

— A sidewinder about to capture a meal at high noon. How can you simulate sunlight and temperature?

— A gila monster in its natural habitat of New Mexico co-existing with other animals!

— Plant life in an oasis on the Sahara.

— An army of dunes on the march! How will you show the ridges of these dunes?

— Little carpets of vegetation surrounding leafy trees on the fringe of the Simpson Desert in Australia.

— A mummified animal on Egypt's bacteria-sparse Western Desert.

— A cross-section of a desert showing an underground water supply. How will you show actual water under the sand?

— Camel driver crossing the Sahara Desert. An oasis is off in the distance.

— A landscape of orange and yellow poppies in the Mojave Desert's Antelope Valley.

— Vegetation of the Kalahari Desert. Include a Bushman in your scene.

— Show a sandstorm and its effects on a desert. How will you create a wind? Better use a closed container for this one!

The desert is the dominant landscape of our solar system. Mars shivers in its aridity while Venus bakes. Earth has managed to keep its oceans and foster life. Still, one-third of our land mass is arid. Earth's deserts are always changing. Locations vary as continents drift, mountains begin and old climates change.

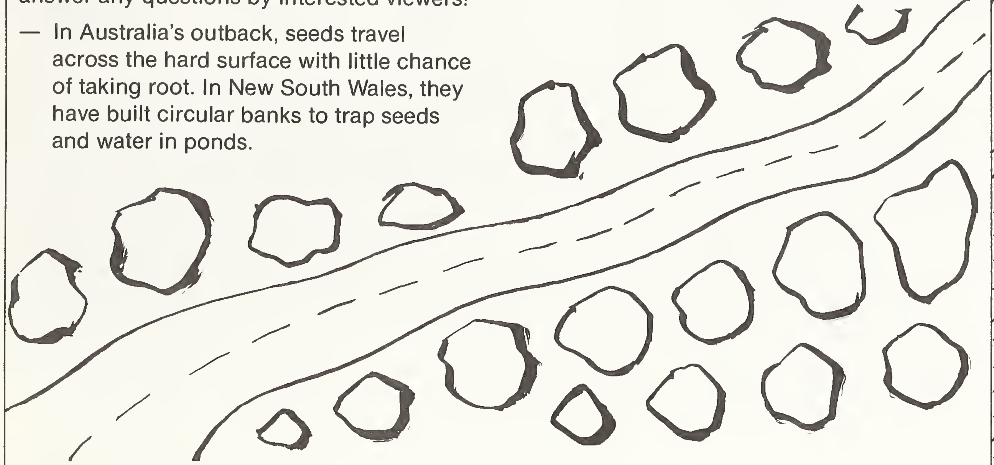
Yet all is not bleak! Even though we are losing ground in some areas, technology has changed land in other areas. New techniques may not only help us to tame our own deserts but......let us some day live on the moon or Mars.

Technology has changed land in some parts of the world's deserts. In this activity, you will see how some countries have turned dry deserts into useful land to help people, animals and plants. There is a new desert maker .... MAN!

Man Fights Back and Wins
The desert

Choose ONE of these models and try to make it as authentic as possible. Ask your librarian if you can display your finished model in the library and be present during noonhour to answer any questions by interested viewers!

- In Australia's outback, seeds travel across the hard surface with little chance of taking root. In New South Wales, they have built circular banks to trap seeds and water in ponds.



- In the Negev Desert of Israel they have replanted forests of trees that fluorish in that climate.

Ecosystem Earth, Activity Card 6

MAN FIGHTS BACK AND WINS (continued)

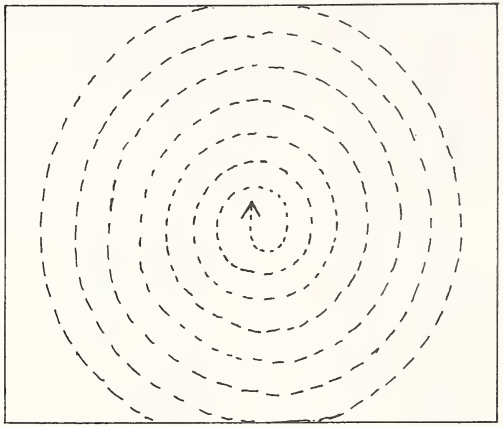
vegetation **irrigation pipes**

Read every project carefully. There are 'clue' words given to you.

Include these clues in your project!

plastic greenhouse **moisture** **bushes**

- In Egypt, they have planted many rows of bushes between the crescent-shaped sand dunes and the crop area. These bushes stop the dunes edging their way onto cropland.
- Iran has decided to construct long rows of holes about the diameter of manholes. These holes lead to qanats. This way they channel groundwater from the highlands downhill to make arable farmland.
- In Israel they have created a goabex (a goat and ibex). What do you think it would look like and what kind of vegetation would it eat. Show this in your model.
- Israel's Negev Desert has had a plastic revolution! They have constructed huge plastic greenhouses where they grow green peppers. The moisture from the plants and soil escapes into the air of the greenhouse. This moisture condenses on the inside of the plastic greenhouse walls, runs down the walls in rivulets and is recycled back to the plants and soil. How will you create the heat and moisture? What little plants could you use that require so much moisture?
- In a desert area near Alice Springs, Australia, they plant seeds in patterns to give vegetation a foothold.



- In the Negev Desert, they have installed irrigation pipes above ground that trickle water onto the soil. They now grow oranges, apricots and vegetables for use on European tables!
- Iran has designed a new type of house that has tall towers. These desert homes' towers act as wind catchers and funnel the breeze down the towers to keep their houses cool.
- On the Atacama Desert in Chile — the farmers direct the rivers from the high Andes Mountains to deep canyons. These canyons provide irrigation to the normally dry land. (How will you show the mountains, the canyons and the dry land with an irrigation system on it?)
- Iran fights shifting sands with its chief resource — oil. Near Ahvaz they spray sand with an oil residue from tanks on bulldozers. The oil mist dries to a mulch that holds moisture and shifting dunes in place. Now they can grow fields of lettuce and tomatoes. How will you show these gray land areas with lettuce growing on them?

ANTS

Studying the behaviour of ants is a fascinating task. How do ants find their way? They always seem to be on the move! To learn about ants and their behaviour, you will need to observe them in their own environment.

You will need: a piece of paper
crumbs of various size
bottle of nail polish
a cloth
a little molasses
a little honey

Lie on the grass or ground near an anthill. If there are a number of ants present, place a dot of red nail polish on the back of one of the ant's thighs. Now you can identify your own ant. Be very still, the action is about to begin!

- Follow your ant's activity for two or three minutes. Does it travel in a straight path?
- Approximately how far has it travelled?
- With the piece of paper, pick it up and place it where it was a few minutes ago. Did it take a similar path?
- Does it always travel at the same speed?

Ants feel the surface of the ground with their antenna following trails which lead them back to the nest. Each ant follows the trail of the one ahead of it.

- Now wipe your finger hard across the trail several times. This will brush most of the scent away and confuse the ants. Watch the next ant that comes along. It will probably stop, circle and go from side to side. How could this hinder the ant's ability to find food?
- Is there an ant carrying anything? If so, what?
- If not, drop a few of your crumbs — they will pick them up. How much larger is the article it is carrying in comparison to its own size?
- Take away the article and place it a short distance away. Does it pick it up again and continue?
- Put a piece of food near it. How many ants arrive?
- Where did they take it?
- Leave a piece twice as large. Do twice as many ants come and take it away?

Ecosystem Earth, Activity Card 7

ANTS (continued)

- Tear your cloth in half.
- Soak a corner of one of the cloths with a little molasses. Drag this section on the ground away from the anthill. This provides a scent trail. Do the ants travel along this trail?
- You might wish to try another scent, like honey. What happened?

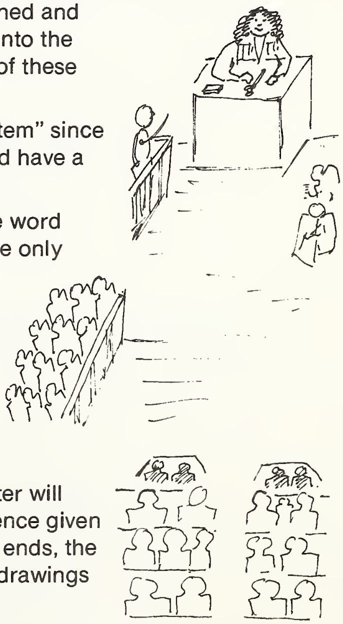
Using the above findings — can you suggest a system to discourage ants in lawns or gardens?

Suppose you found that ants have moved into your house. How could you discourage them other than using insecticides?

Ecosystem Earth, Activity Card 7 (continued)

THE POLLUTERS VS. THE LAW

You are a game warden and on your rounds at a nearby lake you have discovered dead trout floating on the water. Water samples were examined and they revealed that a local company had dumped harmful chemicals into the lake a week earlier. Samples of dead fish contained large quantities of these chemicals.



You have charged the company with "wilful damage to the ecosystem" since you had advised them on several occasions that their dumping would have a detrimental effect on the local ecosystem.

This will be a tough case, because the company is questioning the word "wilful". They claim that their intentions were not to cause harm since only small quantities were dumped.

These people will be part of the courtroom scene:

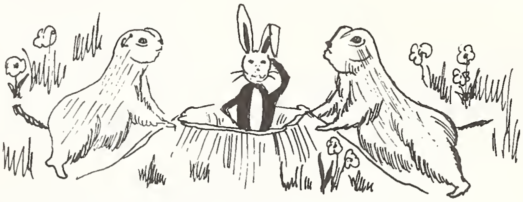
bailiff
court artist
defending attorney
game warden
2 company officials
judge
prosecuting attorney
chemical analyst
TV reporter

Since this trial may take several days to settle, the television reporter will bring the public (the rest of the class) up to date with the latest evidence given at the trial on the "Late Flashes" news broadcast. Also when the trial ends, the reporter will inform the public of the jury's verdict. The court artist's drawings can be shown during each news broadcast.

Get some friends together and plan your strategies for this tough case!!

Ecosystem Earth, Activity Card 8

LIFE IN A PRAIRIE DOG TOWN



Flying mud erupts over a young prairie dog, as its parent repairs their burrow damaged by rain.

Snapping to attention, the adult prairie dog freezes and peers toward the horizon. The black dot in the sky advances. Other prairie dogs sit up and watch the oncoming intruder. One barks a warning and they vanish to safety into their network of burrows. Failing to snatch a prairie dog for its next meal, the eagle flies elsewhere. Communication is crucial to prairie dogs' survival!

This tense life for the prairie dog is common. Two hundred years ago thousands of them inhabited the prairies. One hundred years ago the cattleman and wheat farmer arrived. They considered this little rodent a pest and felt it threatened crops and livestock. As a result, poisoning, drowning, shooting and other methods of eradication almost pushed the prairie dog into extinction.

Their diet consists mostly of grasses, grains, alfalfa and leafy weeds. They need to consume great quantities — in fact, they consume more than twice their own weight each month. The animals must store fat to last them over the winter.

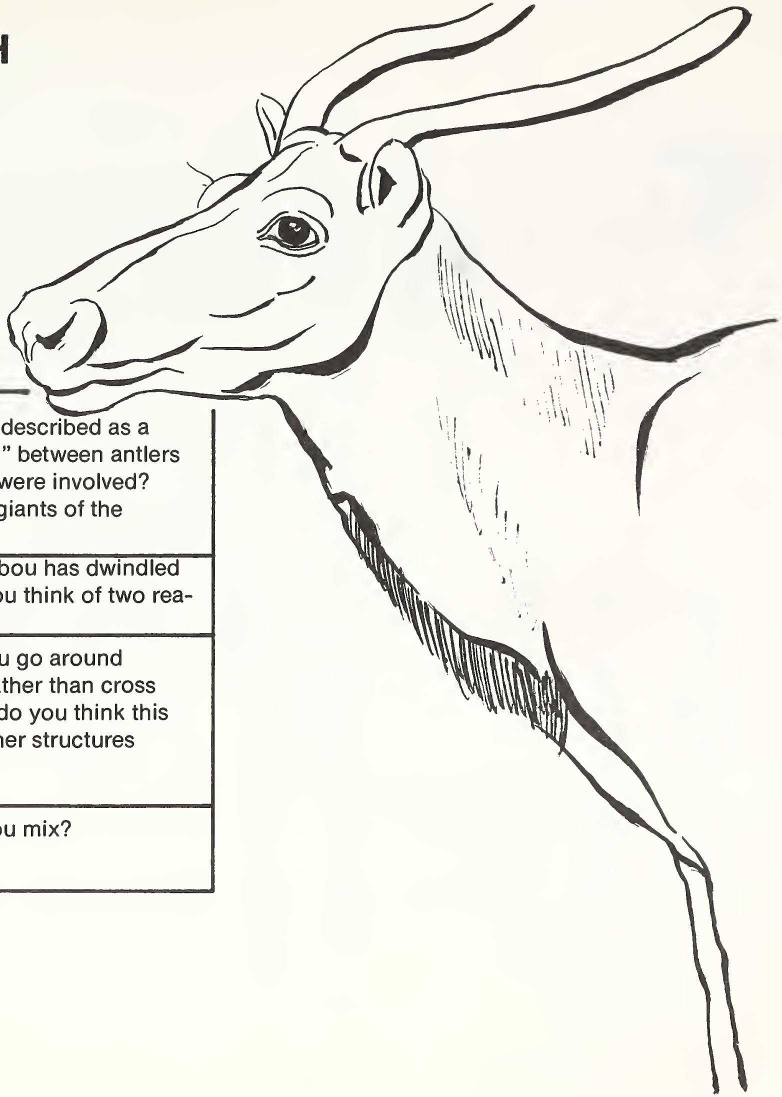
- What enemies, other than man, do the prairie dogs have?
- Describe the place of the prairie dog and other living and non-living things in a prairie ecosystem.
- Why do you think that a farmer would be upset at a heavy population of prairie dogs on rangeland?
- Prairie dogs do cause short-term losses on rangelands and croplands. What beneficial influences might they have on a grassland ecosystem?
- There is a new ecological ethic today that recognizes the right of all plants and animals to share this planet. Do you feel that the prairie dog should have a corner of our planet saved for it? Support your viewpoint.
- With three friends, make a model of a prairie dog town. You will need to show a nesting chamber, a room for storing food, a turning bay.

Ecosystem Earth, Worksheet 4

THE CARIBOU OF THE NORTH

Few animals are capable of surviving in so many different types of terrain — rugged steep mountains or hummocky lowlands. The caribou is a creature of vast open spaces. When the wide open spaces of the northland disappear, so will the caribou.

As northern Canada builds cities, roads, pipelines, powerlines and railroads — vast areas will be closed, shrinking the available range. Add tourists, hunters, snowmobiles and cars. The caribou population will change.



Caribou — Hardy Nomads of the North What does this mean?	A scene in the North was described as a "seven-minute showdown" between antlers and claws. What animals were involved? (They were described as giants of the north.)
Can you think of four natural factors that could affect the population of the caribou?	The yearly harvest of caribou has dwindled in the last decade. Can you think of two reasons why?
The caribou are browsers and they take very little as they "crop" (eat). (a) How will this benefit the alpine & arctic plants? (b) What do they eat?	It seems that most caribou go around obstacles like pipelines rather than cross them or use ramps. How do you think this will affect them? What other structures might affect their trails?
The "iron dogs" offer job competition to man's best friends in locating caribou. What are the "iron dogs"?	Will oil, tundra and caribou mix?

Obtain a piece of coloured cardboard. Glue these pages to cardboard to make an accordian-like booklet.

STAMP OUT POLLUTION!

Enforcement Officer 'Buzz' Stack says that pollution is becoming a big problem and he's out to find the offenders.

He's hired you — an advertising agency — to design a poster to stamp out *one* of these forms of pollution:

- airline companies — air pollution
- chemical companies — water pollution
- jeeps—plant and forest destruction
- garbage dumpers — creek and roadside pollution
- car companies — air pollution
- motorcycle manufacturers — noise pollution
- diesel truck manufacturers — air pollution

To be effective, a poster must be eye-catching. An effective poster should be short and to the point and have simple but poignant drawings. Study a variety of posters on display in your neighbourhood. Design yours in black and white or bright colours. Display your poster in a prominent place in your school.

Ecosystem Earth, Activity Card 9

TRAFFIC ANALYST

You are going to be a traffic analyst today. A traffic analyst collects data at various times of the day at the same location, and then studies the information to:

(a) see if the amount of traffic is greater at one time of day than another
(b) determine the type of community (working or retired, business or residential, tourist area, shopping district)

Get together six friends and decide which kind of data you would like to collect:

Number of — cars passing intersection
— cars passing with only one person
— cars with driver and passenger(s)
— female drivers
— male drivers
— female drivers with children
— service trucks
— recreational vehicles

Each of you will need: a clipboard
a pencil
a traffic survey data sheet
a watch, clock or stopwatch

- Choose a busy corner in your community where you feel that a large number of cars pass at 8 a.m.
- Each time that you see a car pass you (in either direction) that relates to *your* category, put a small check (✓) mark under that time period on your sheet.
- Collect this information for 15 minutes and then return to the school.
- Return to this same spot at 10:30 a.m. and 12:15 noon and do the same as you did at 8 a.m.
- How many cars and trucks altogether passed this corner?
- Which category received the most check marks?
- Speculate on reasons why you think this is so.
- How many male drivers passed this corner altogether?
- How many female drivers passed this corner altogether?
- Which group formed the greatest number of drivers?
- How would you classify this community?

Ecosystem Earth, Activity Card 10

TRAFFIC SURVEY DATA SHEET

VEHICLES	8 A.M.	10:30 A.M.	12:15 (NOON)
PASSING THROUGH INTERSECTION			
ONE PERSON ONLY			
DRIVER AND ONE PASSENGER			
FEMALE DRIVER			
MALE DRIVER			
FEMALE DRIVER WITH CHILDREN			
SERVICE TRUCKS			
RECREATIONAL VEHICLES			

Ecosystem Earth, Activity Card 10 (continued)

NOTES

DATE DUE SLIP

JAN 26 RETURN	OCT 22 RETURN
DUE EDUC FEB 22 '84	DUE EDUC MAR 12 '91
FEB 23 RETURN	MAR 12 RETURN
DUE EDUC MAR 29 '84	DEC 05 '91
DUE EDUC APR 15 R	NOV 28 1991 RETURN
MAR 30 RETURN	DUE EDUC MAR 31 '92
DUE EDUC OCT 26 '89	APR 01 1992 RETURN
DUE EDUC NOV [illegible] R	DUE EDUC JUN 14 '92
DUE EDUC DEC 05 '89 R	JUN 03 1992 RETURN
DUE EDUC DEC 19 '89 R	EDUC MAR 05 '93 R
DUE EDUC JAN 03 '90 R	EDUC MAR 15 '93
DUE EDUC JAN 1[illegible] R	MAR 14 RETURN
JAN 15 RETURN	DUE EDUC NOV 21 '93
DUE EDUC MAR 14 '90	1993 NOV 10 RETURN
MAR 05 RETURN	DUE EDUC NOV 30 '93
F. 255	1993 NOV 24 RETURN DUE EDUC DEC 31 1993

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